1940, No. 3 NOVEMBER 14

COPEIA

Established in 1913

PUBLISHED BY
THE AMERICAN SOCIETY OF ICHTHYOLOGISTS
AND HERPETOLOGISTS

Copeia 1940, No. 3 November 14

CONTENTS

Published quarterly by the American Society of Ichthyologists and Herpetologists, at the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, under the Act of August 24, 1912. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized February 11, 1924.

Status of the Name *Rana grunniens* Daudin

By Leonhard Stejneger

In a very important and interesting paper, *Some Works of Bartram, Daudin, Latreille, and Sonnini, and their Bearing upon North American Herpetological Nomenclature* (in Amer. Midland Natural., 23 [3], May, 1940: 704–706), Dr. Francis Harper has critically discussed the status of the name *Rana grunniens*.

It first appears in the second volume, p. 155, of Sonnini and Latreille's *Histoire Naturelle des Reptiles* (18mo, Deterville) which Dr. Harper shows was published probably before December 17, 1801.[1]

The brief and rather loosely drawn [2] description contains nothing to indicate that it was not written by Latreille, but barely more than two months after its publication Daudin (February, 1802) stated that he had furnished it and that it was a "description abrégée" by himself of his more elaborate treatment of the species in his Rainette monograph,[3] a statement which has never been contradicted by Latreille or any other author.

Brief and defective as it is (a complete translation is given by Harper on p. 705) Daudin's preliminary introduction of the species makes a definite reference to the "two individuals of this species, placed in the Paris Museum of Natural History," which "have a streak of several elongated spots of yellowish behind the eye." This characterization of cotypes in a great public museum is the primary basis of the specific diagnosis, to which is added the secondary literary reference to a frog (as it turned out) mistakenly supposed to belong to the same species, even though this reference may fill more space on the printed page.

Daudin's complete description as it appeared in the "Rainettes," fol. ed., p. 42, is translated as follows:

XIII. GRENOUILLE GROGNANTE. *RANA GRUNNIENS**

Rana fusca aut sub-rubra, luteo post oculos maculata.

I have noticed in the collection of the Museum of Natural History at Paris two frogs more than four and one-half inches long, legs excluded. One is entirely of a brownish blue a little slate-colored above and white without spots underneath, with a yellowish streak (*trait*) behind each eye. The other of a reddish chestnut (*marron*) above, whitish shaded with chestnut (*châtain*) underneath, with several small yellowish streaks, short and elongated, behind each eye. (It is the second which is figured here [pl. 21].) The digits of front feet are four in number, all separate; and the posterior ones are broadly palmate, five in number. Their colors seem to have been changed by the alcohol. The form of their head is rather similar to that of the green frog of Europe, that is to say that it is triangular, a little lengthened in front and flattened at the sides of the mouth. The entire skin is smooth, especially below.

Bartram in his Voyage en Caroline et en Floride, chap. X, mentions a frog about eight or nine inches long from the tip of its nose to the extremity of the hind feet. It is without doubt the same as the grunting frog. It is, according to Bartram, the largest frog seen in Florida and on the seacoast of Carolina. The parts around the mouth

[1] The fact that Daudin's volume 2 of *his* Histoire Naturelle des Reptiles, published on that date, contains page references to Latreille's work does not absolutely prove that the latter had been formally *published* before that date. The relations of the two authors at that time were so close that page proof may well have been available to Daudin, who had furnished part of the matter contained in Latreille's "petite édition de l'Histoire Naturelle des Reptiles, à laquelle j'ai travaillé avec mon ami Latreille, pour le libraire Déterville" (Hist. Nat. Rainettes, ed. fol.: 10, note dated Febr. 20, 1802).

[2] "Considerably less professional than that in Daudin's usual works." (Harper: 702).

[3] Rainettes, fol. ed.: 10. "Tous les Batraciens dont j'ai déjà donné une description abrégée dans l'*Histoire Naturelle des Reptiles, par LATREILLE*, seront indiqués dans ce nouvel ouvrage [Rainettes] par une étoile qui suivra leur nom spécifique latin," and *Rana grunniens* is so indicated on p. 42.

and the lips are yellow; upper parts of body are of a brown or black color; the underside is white with shadings and spots more or less brown and varied of form; in addition it has the femur and tibia marked transversely with black or dark brown bands. This frog lives in the wet marshes, on the banks of the lakes and great rivers of North America. It has a strong and disagreeable voice rather resembling the grunting of a hog; but it is not so noisy as the bullfrog.

This description was reproduced verbatim by Daudin in the eighth volume of his *Histoire Naturelle des Reptiles* (1803: 127), with the addition of a synonymy which begins with "La grenouille grognante. Daudin, Hist. nat. des reptiles par Latreille, in –18, tom. II, p. 155."

It is plain from the above that Daudin based his species exclusively on the two specimens in the Paris Museum and that he only, mistakenly assuming its identity (as it turned out later), added Bartram's description and observations.

Thus the status of *Rana grunniens* remained for nearly 40 years, except that Merrem, in 1820, listed it in his *Tentamen*.

Here is what this alleged "reviser" of Daudin's complex species *R. grunniens* writes (Tent. Syst. Amph.: 174 bis):

> [RANA] *grunniens* 3. R[ana] plantis palmatis, corpore angulato glabro, capite elongato subcompresso. *p*)
> *Habitat in* America.
> Dorsum tuberculis duobus.
> *p*) R. grunniens, Latr. *rept.* II, p. 155. Daud. *ran.* p. 65[quarto edition] t. 21. *rept.* VIII. p. 127.

That is all. And he does not even mention Bartram's name or book! Moreover, not one word of his diagnosis is taken from the text in Latreille's book; it is all from Daudin's description in the *Rainettes*. Note and compare with the above diagnosis: "Les doigts de leur pieds . . . postérieurs sont largement palmés," "toute la peau est lisse," "leur tête est . . . triangulaire, un peu prolongée en avant, et applatie sur les côtés de la bouche."

And finally Merrem of his own adds: "corpore angulato" and "dorsum tuberculis duobus," this last in the German text rendered "Kreutz höckerig," showing that by the two "tubercles" he meant the protruding angles of the iliosacral articulation. These characters are not alluded to in any of the Daudin-Latreille texts, but Merrem evidently deduced them from the picture of the specimen in the Museum in Paris, which became the lectotype of *R. grunniens* Daudin in Latreille! As for the "type locality" America, that was not supplied by Merrem, he simply copied Daudin. There was no "revision" by Merrem in the sense of the international code of zoological nomenclature.

The status of the name was not changed until 1841 when Duméril and Bibron, respectively "administrateur" and "aide-naturaliste," of the Museum of Natural History at Paris, after re-examining Daudin's two cotypes of *Rana grunniens* still in the museum, announced that these specimens represented two different species, for one of which the name had to be retained.[4] Quite properly they reserved the name for the specimen which Daudin had

[4] Erpétologie Générale, 8, 1841: 341. "Daudin, in the article on his *Rana grunniens*, tells us that this species is founded on the examination by him of two large frogs in the Museum of Natural History at Paris. . . . As these two frogs still exist today in our establishment, we have been able to compare them with care, which has led us to recognize that so far from being specifically similar, they belong on the contrary to two entirely different species."

figured on plate 21. The origin of this specimen (the lectotype) was unknown to them, but the museum then possessed a second specimen which they considered conspecific and this individual came from the isle of Amboina, where the species still occurs (Van Kampen, Amphibia of the Indo-Australian Archipelago, 1923: 173, 284). Their belief that the species might also occur in Java, where a nearly related species actually occurs, has nothing to do with the case.

It should be noted, however, that Daudin's other cotype belongs to *Rana hexadactyla* Lesson which they renamed *Rana cutipora*.

To sum up: The introduction of *Rana grunniens* was made anonymously by Daudin in Latreille's *Histoire Naturelle des Reptiles* (*2*, 1801: 155), based primarily on two cotypes in the Paris Museum. Daudin a few months afterwards published a more complete description with a colored plate of one of the cotypes believing it to be the same as an American frog described by Bartram. The status of the name remained unaltered until 1841, when Duméril and Bibron restricted it to the one of Daudin's cotypes which he figured. This action has been ratified for 99 years by all authors dealing with Indo-Malayan frogs, until now it is proposed to transfer it to a frog described by Bartram as occurring in Florida and on the seacoast of Carolina. But surely, the action of Günther, Boulenger and Van Kampen in following Duméril and Bibron was neither "erroneous nor invalid."

U. S. National Museum, Washington, D. C.

Color Changes in Blindfolded Anoles

By F. H. Wilson

DURING the early summer of 1939 experiments with a lizard, the common anole of the southern states (*Anolis carolinensis* Voigt) were tried by the writer in an attempt to combine studies of background reactions and reactions to color filters. The results suggested the necessity of experiments with blindfolded individuals before engaging upon further work involving photo-reception through the eyes.

The specimens of *Anolis carolinensis* used in my experiments were caught on the Tulane University campus and given a light anesthesia with ether. Their eyelids were brought together and painted with a solution of celloidin with which finely powdered charcoal had been mixed. This solution quickly hardened, holding the eyelids closed and preventing light from entering the eyes. The animals were thus effectively blinded without injury. They were then placed in individual glass jars with holes in the covers permitting the circulation of air, and they were kept for at least a day before using them for experimentation. Before each series of experiments they were placed in a light proof box for at least a half hour, or until all were green, before they were exposed to the experimental illumination.

Reactions to Light

Preliminary experiments showed, as expected, that their reactions were not affected by background. There was not the expected browning of all individuals when exposed to light, however, suggesting that there might be an unequal sensitivity to light varying with the individual. Experiments to test this were devised using the ordinary electric light bulbs for illumination and a Weston Foot-Candle Meter, model 614, to measure the intensity. Results showed that some anoles would become brown at a light intensity of two foot-candles in about two minutes, while others might require a longer exposure or more intense illumination or both. The majority browned within a two minute exposure to fifteen foot-candles. Two extreme individuals required an exposure of thirty minutes to 400 foot-candles to induce the brown phase.

In the weakest light inducing browning, the top of the head or neck and the lumbar region of the body were usually the first to show a reaction by assuming a yellow-brown color which spread posteriorly and anteriorly until the mid-dorsal region was completely yellowish brown which then spread ventrally over the sides of the body. In the weaker lights, however, it did not completely cover the sides but left the ventral portions green. The lizard thus appeared yellowish brown and green. If this degree of illumination was maintained, a considerable fluctuation in the sizes of the green areas and the yellow brown areas was noticeable. Stronger light would usually induce a deeper brown although occasionally an individual would become green; weakening the light would usually bring about green coloration, but an occasional specimen would turn brown. At least four of more than two dozen specimens turned brown completely when exposed to light and within five minutes returned to the green phase. They repeated these changes with varying intervals although there had been no change in light intensity. In order to determine what the permanent color would be for anoles exposed to a constant illumination over a long period of time, seven were exposed to light of forty foot-candles. They all became brown in two minutes but one returned to the green phase by the end of thirty minutes. At the end of four hours another had become green. At the end of sixteen hours a third had turned green, so that as the result of exposure to a constant illumination for sixteen hours there were four in the brown phase and three in the green phase. When placed in the darkness the brown lizards became green in less than five minutes, a shorter time than that usually required by brown lizards which had been exposed to a similar light for only ten or fifteen minutes.

In the above experiments the lizards were all illuminated from overhead, which gave each specimen an even illumination except for the ventral side. There had been indications during the above experiments that unequal browning might be obtained by unequal illumination of the right and left sides, particularly if light of an intensity close to that required to just induce the change to brown was used. To check these chance observations a cage was made by placing two glass plates together and separating the ends with modeling clay sufficiently to allow the lizard to move about comfortably but not enough to allow him to turn over easily. The sides were closed with

cellophane. Black carbon paper was wrapped around three sides of the cage. The top piece was held down by a weight so that the black paper could be quickly lifted to observe the coloration of both sides. On exposure to proper illumination (a flashlight is excellent) one can watch the uneven change to brown on the illuminated side and if the black flap is quickly lifted the opposite side may be seen to be much less brown, or even green. Care must be taken that the light source is sufficiently weak and that the animal stays quiet. If the illuminated side becomes too brown, the other side will be found to be equally brown, likewise if the anole is restless. Lizards requiring a strong light to induce the change to brown are most subject to this asymmetry in coloration.

In none of the lizards did illumination from the ventral side show any results differing markedly from those illuminated from overhead.

Reactions to Temperature

From time to time blindfolded anoles in the green phase were placed in an electric refrigerator which maintained a temperature of 10° to 13° C. Most of them turned brown in approximately two hours and stayed brown the entire time that they were in the refrigerator. A few were green with brown ventral sides at the end of twelve hours but became brown when the temperature was lowered to 9° to 10° C. A few that had been brown became green or green and brown if the temperature was allowed to stay long at 13° C., suggesting that this temperature was, for some of them, close to the critical temperature for the change from green to brown for these animals. The refrigerator was of course dark; to test the effect of light and cooling, individuals were cooled by packing ice around their containers while exposed to light of fifteen foot-candles. They turned brown and stayed brown for two hours while these conditions were maintained.

Exposure in the light to temperatures of approximately 50° C. induced the change to green in lizards which had been previously brown. They died quickly if the temperature was allowed to go much higher. The temperature in the photographic darkroom in which all of the above experiments were carried out varied between 30° and 35° C. Anoles when placed under 400 foot-candles illumination to induce the change to brown had been at 44° C. and the change had occurred at this temperature. This places the temperature at which color reactions change under the influence of temperature as being somewhere between 44° C. and 50° C.

Summary

Blindfolded lizards, *Anolis carolinensis* Voigt, turn green when placed in a light proof box, and when removed from darkness show varying reactions to light. Some turn brown when exposed to a relatively weak light while others require an intense illumination to induce the change to brown. Those few which do not turn brown by increasing the light intensity do so when transferred from strong to weak light. Exposure of only one side to the proper intensity of illumination induces the change to brown on the lighted side. High temperature with light induces green coloration and a low temperature induces brown whether in light or in darkness.

Department of Zoology, Tulane University, New Orleans, Louisiana.

The Races of *Ambystoma tigrinum*[1]

By Emmett Reid Dunn

IT is well known that Cope, after prolonged study, came to the conclusion that it was not possible to subdivide the general population of *Ambystoma tigrinum* on structural characters. I am of the same opinion, after examining much more material than was available to him. I further think that *bicolor, conspersum, copeianum, trisruptum,* and *xiphias,* which he recognized on structural characters, and of each of which he had only a very few specimens, are conspecific with *tigrinum.* Four of these appeared in the 1917 edition of the *Check List,* but were dropped, on my insistence, in the edition of 1923.

I cannot understand why *bicolor* was ever considered different from the other New Jersey specimens. *A. conspersum* was based on the smallest transformed specimen of *tigrinum* yet known, and Cope's later concept of it was largely based on three specimens of *A. mabeei* (ANS 1402 from Charleston, S.C., and ANS 1400–1 from Liberty Co., Ga.). *A. copeianum* and *A. xiphias* were based on very old males. *A. trisruptum* seems to me a perfectly normal New Mexican specimen, and I cannot see why it was considered different. I have examined the types of all these forms.

I have had a plethora of letters and of conversations with experimental biologists who work with this species, pointing out to me that the species was made up of a number of races which differed in their physiology, and asking me, as an amphibian taxonomist, to divide the species into geographical races. First in time and importance of these men was Dr. Ross Harrison of Yale. After some twelve years of work on the problem I offer a preliminary arrangement. The work has met certain inherent difficulties and is incomplete.

The principal difficulties are:

1. Lack of material from critical localities. Unless one has a series of adults from a locality it is difficult to be certain what form is present there. Single specimens may be very misleading.

Fortunately, no one has based any conclusions or names on single specimens in this group of *Ambystoma* for many years. Southern Arizona, and the East Texas-Louisiana-Mississippi area are not sufficiently known to be included in the range of any race, although the species occurs in both areas.

2. Variability.

(a) There is in each area a very considerable change in structure and in color associated with age. The most notable of the former is an increase in the relative length of the tail. The color changes are concerned with the relative amount of light spotting and dark background, the former usually increasing, although the reverse may occur.

(b) Males usually have a greater relative tail length. No sexual color characters are known.

---

[1] Contributions from the Department of Biology, Haverford College, No. 46.

(c) There is a great deal of variation which cannot be correlated with age or sex. The literature is full of references to it. Much of it is probably not hereditary. Individual specimens from widely separated areas and of quite different populations may be indistinguishable, and this is why a series is often necessary.

(d) It should not be necessary to warn students against differences due to different fixation or preservation, but some egregious errors from this source have gotten into print recently.

Thanks to the kindness of many persons I have been enabled to examine over 1350 specimens of *Ambystoma tigrinum*. Of this total somewhat over 750 were past the transformation period. Larvae and recently transformed young are usually useless in racial discrimination.

Of the 750, 23 are from Canada, 82 from Mexico, and the rest from the United States. This material is inadequate, but it is more than any one investigator has previously been able to study.

This material can be arranged into a number of races based primarily upon adult coloration. Precise boundary lines cannot be given, partly because of lack of material, partly because they seldom exist. With few exceptions any type may be found, as a variation, in the area of any other type. I lay little or no stress on structural characters, as I find them (as did Cope) not aligned geographically.

The typical, or New Jersey, form is characterized by nearly circular yellow spots, of differing sizes, irregularly arranged on back and on sides. This coloration extends west into Minnesota, Iowa, Missouri and Alabama. It is also found in Plateau Mexico and in the Valley of California, but in these areas there is less spotting on the back and perhaps more on the sides, and this, together with differences in egg-laying, in length of larval life, and in number of gill rakers, makes it possible to recognize a Mexican race, *velasci,* and a Californian race, *californiense*. The form of the southern Great Plains (Kansas, Oklahoma, Texas, most of New Mexico, Colorado) has vertical yellow bars which usually do not cross the median line dorsally or ventrally. For this the name *mavortium* is available. Northeastern North Dakota and adjacent Canada is populated by a gray race with markings of black dots. This has not been named. Northern Arizona, Utah, and parts of New Mexico and Colorado have animals with dark and uniform color, yellow spots showing faintly in the young, for which *nebulosum* is available.

From Nebraska and South Dakota, northwestward through Montana, Idaho and Washington, the dark background is reduced to a network, the yellow color of the light areas is replaced by whitish, and the outlines are very blurred. This form has not been named.

I know of no area in which *tigrinum* is normally neotenous. Neoteny is very rare or unknown in *t. tigrinum* or *t. californiense*. It is not infrequent in *t. diaboli* (cf. Osborn, 1900), in the northwestern race (cf. Slater, 1934 and Powers, 1903 and 1907), in *mavortium* (Gadow, 1908: 14, ripe ♀ larva in BMNH from Estes Park), in *velasci* (ripe larval females in BMNH from Jalisco); it is not definitely known in *nebulosum* (unless the ripe male larva in the BMNH from "Mt. Lakes of California" belongs to this race), but the

abundance of large larvae from its range renders it probable.

The largest specimen seen is a larva of *mavortium* from Ft. Union, New Mexico, USNM 4067, which has a total length of 328 mm. The largest transformed specimen is the male type of the North Dakota race, UMMZ 50156, 287 mm. in total length.

The species seems to be absent from New England and the Appalachian uplands; central and southern Florida; Nevada; California except for the Central valley; most of Oregon and western Washington. It barely enters Ontario and is not known from Quebec, but is otherwise present in southern Canada. It seems to occur pretty much over the whole of the Mexican plateau, and onto the coastal plain in Vera Cruz.

Ambystoma tigrinum tigrinum (Green)

1825 *Salamandra tigrina* Green, Jour. Acad. Nat. Sci. Phila., 5: 116, f. 1–2. Near Moore's town, New Jersey. Type not known to exist.

1839 *Salamandra lurida* Sager, Sillman's Jour. 36: 322. No locality mentioned. Specimens sent by Sager as *lurida* are USNM 3970, 3899, 39442, all from Detroit, Michigan. The last agrees with Sager's original measurements. Not *Salamandra lurida* Rafinesque, 1832.

1858 *Amblystoma bicolor* Hallowell, Proc. Acad. Nat. Sci. Phila., 9: 215. Beesley's Point, New Jersey. Type ANS 10584.

1859 *Amblystoma conspersum* Cope, *Ibid.*, 11: 123. Londongrove, Chester Co., Pennsylvania. Type ANS 10589.

1868 *Amblystoma xiphias* Cope, *Ibid.*, 19: 192. Columbus, Ohio. Type USNM 14470.

1868 *Amblystoma obscurum* Baird, in Cope, *l.c.*: 192. Fort Des Moines, Iowa. Type USNM 3994.

1885 *Amblystoma copeianum* Hay, Proc. U.S. Nat. Mus., 8: 209, pl. 14. Irvington, Indiana. Type USNM 14112.

RANGE.—Long Island to Northern Florida, to Minnesota, to Missouri. Absent from most of the Appalachian uplands.

DIAGNOSIS.—A yellow-spotted race with spots as abundant on dorsum as on sides; eggs laid in masses; larvae with 19–20 gill rakers on anterior face of third arch.

REMARKS.—A very large larva from Micanopy, Fla. (USNM), may indicate neoteny as occasional there. The light spots seem to increase in size with age in most areas. Some large specimens from the Mississippi Valley (Chicago, Memphis, New Orleans) and from Corpus Christi, Texas, show a general obscurity of the yellow spotting (cf. under *incertae sedis*).

Records (and USNM 14488 from Auburn, Maine) from New England are all extremely dubious. The animal should be looked for on Cape Cod. In eastern states specimens are almost confined to the Coastal Plain. Possible exceptions are: Albany, N.Y. (Eights, 1836, Zodiac, 1: 132; specimen apparently still extant); Suffern, N.Y. (AMHN 2327); Londongrove, Chester Co., Pa. (ANS 10589); Edgefield, S.C.

I have seen 7 adults and many larvae from Long Island, 3 larvae from Staten Island, 13 adults from southern New Jersey, one adult from Vienna, Md., one adult from "Virginia." It has been recorded from Sanford and from Moore Co., N.C. I have seen 16 adults from South Carolina, 2 adults from Georgia, 2 adults and a larva from Alachua Co., Fla.; 3 adults from Alabama (Bibb Co., Montgomery, Mobile); 2 adults from "Mississippi";

one adult from Fayetteville, Ark.

In Canada, Patch writes me it has been taken at Pt. Pelee, Ontario. I have seen one larva from Pittsburgh, Pa.; 8 adults and 8 larvae from Ohio; 2 adults from Russellville, Ky.; 3 adults from Tennessee (South Knoxville, Clarksville, Memphis).

The animal seems generally distributed in Indiana (18 adults, 9 larvae); Illinois (74 adults, 118 larvae); Michigan (37 adults, 43 larvae); Wisconsin (16 adults, 7 larvae); Minnesota (11 adults, material from western part of state not sufficient); Iowa (15 adults, 11 larvae); Missouri (10 adults, 3 larvae).

Ambystoma tigrinum velasci Dugés

1844 *Axolotes maculata* Owen, Ann. Mag. Nat. Hist., 14: 23. Sierra Madre, Chihuahua, lat. 26°6′ N, long. 106°50′ W. Type BMNH 41-6-13, 35. A larva. Not *Lacerta maculata* Shaw, 1802.

1879 *Siredon Tigrina* Velasco, La Naturaleza, 4: 216. Laguna Santa Isabel, Guadelupe Hidalgo, D.F., Mexico. Type not known to exist. Not *Salamandra tigrina* Green, 1825.

1891 *Amblystoma velasci* Dugés, La Naturaleza (2) 1: 142. Substitute name for *Siredon Tigrina* Velasco, 1879.

1930 *Ambystoma tigrinum velascoi* Wolterstorff, Abh. Ber. Mus. Magdeburg 6, (2): 132, f. 3, pl. 2, f. 2–3, pl. 3, f. 3. Substitute name for *Siredon Tigrina* Velasco, 1879.

RANGE.—Mexican Plateau (on to coastal plain in Vera Cruz).

REMARKS.—Coloration usually similar to that of *A. t. californiense,* but occasionally quite like that of *A. t. tigrinum.* Neoteny is frequent. The larvae have only 9–15 gill rakers on the anterior face of the third arch.

This race is not known to meet *A. t. tigrinum* or *A. t. californiense.* But it seems to meet an intermediate group in southern Arizona and in southwestern New Mexico which is marked with round yellow spots and has a high gill raker count. Material is too scanty as yet to settle the matter.

I have seen good series from the states of Jalisco and San Luis Potosi. The following material has been available: Chihuahua (6 adults, 4 larvae); Durango (2 adults, 1 larva); San Luis Potosi (49 adults); Jalisco (11 adults, 19 larvae); Vera Cruz (2 adults, 1 larva); Puebla (7 adults, many larvae); Mexico (5 adults, 4 larvae).

Ambystoma tigrinum californiense Gray

1853 *Amblystoma Californiense* Gray, Proc. Zool. Soc. London, 1853: 11, pl. 7. Monterey, California. Type not known to exist.

RANGE.—California from Sonoma and Sacramento counties to Monterey and Kern counties.

DIAGNOSIS.—A yellow-spotted race, with very little spotting except on sides. Eggs laid singly. Short larval life and neoteny unknown.

REMARKS.—This race does not come into contact with any other. Individuals, however, can scarcely be distinguished from specimens of *velasci* or of *tigrinum.*

A neotenic male in the British Museum (250 mm. long from "Mountain Lakes of California," presented by Charles Darwin) is not this form, but may indicate the presence of *nebulosum* somewhere in California. I have exam-

ined 13 transformed specimens from Sonoma, Santa Clara, and Fresno counties. It has been recorded from Sacramento, San Joaquin, Contra Costa, Alameda, Monterey, San Benito, Kern, and King's counties.

Ambystoma tigrinum mavortium Baird

1850 *Amblystoma mavortia* Baird, Journ. Acad. Nat. Sci. Phila. (2) 1: 284, 292. New Mexico, collected by Wislizenius while on Doniphan's expedition. Type not known to exist.

1852 *Siredon lichenoides* Baird, Proc. Acad. Nat. Sci. Phila. 6: 68. Lake at head of Santa Fé Creek, New Mexico. Type USNM 4061.

1868 *Amblystoma trisruptum* Cope, *Ibid.*, 19: 194. Ocate Riv., New Mexico. Type USNM 4008.

RANGE.—Kansas, Oklahoma, central and western Texas, eastern Colorado, central and eastern New Mexico.

REMARKS.—This race has vertical yellow bars which very rarely cross either the middorsal or the midventral line. The markings are usually very vivid. Neoteny occasionally occurs: the larvae normally reach considerable size before transformation, and have 19–20 gill rakers on the anterior face of the third arch. Practically complete transition has been seen between this form and *slateri* on the north, *nebulosum* to the west and *tigrinum* to the east (and possibly to the southwest also).

Nebraska specimens (intermediates) are considered more like *slateri*. Kansas (27 adults, 17 larvae) has *triginum*-like specimens in the extreme east of the state. Of the 21 adults and 22 larvae examined from Oklahoma, all are from the center and west and all are *mavortium*. Fourteen adults and 15 larvae from Texas are *mavortium*, ranging east to Duval Co. I am not sure what form occurs in east Texas, but specimens from Dallas, from near San Antonio, and from Corpus Christi are not *mavortium*.

I have seen 37 adults and 107 larvae from Colorado. Most of these are from the Plains and are *mavortium*, but some from the western part are certainly *nebulosum* and there is complete transition between the two types. It might be convenient to consider the Front Range as a boundary in this state. Of 48 adults and 35 larvae from New Mexico 31 adults are *mavortium*, the range covering all but the western part (Rio Arriba Co., McKinley Co., Luna Co., Pescao, Ft. Wingate). In this state *mavortium* occurs in the plains and up the Rio Grande Valley.

Ambystoma tigrinum nebulosum Hallowell

1853 *Ambystoma nebulosum* Hallowell, Proc. Acad. Nat. Sci. Phila., 6: 209. San Francisco Mt., Arizona. Types USNM 4702, ANS 1294.

RANGE.—Interior Basin and Colorado Plateau in Utah, western Colorado, northwestern New Mexico, northern Arizona.

DIAGNOSIS.—A race of *tigrinum* without definite markings in adult, dark gray or blackish; larvae reaching large size, perhaps occasionally neotenous; 19–20 gill rakers on anterior face of third arch. Young with circular yellow spots.

REMARKS.—This form definitely intergrades with *slateri* in northeastern Utah and southwestern Wyoming, with *mavortium* in central Colorado and in western New Mexico, and with a yellow-spotted form in southern Arizona.

No specimens have been seen or recorded from Nevada. It should occur

there. Possibly a large larva from "Mountain lakes of California" is this form. It should occur in southern Idaho and possibly larvae from "Snake River" and one from Malad (Oneida Co.) may belong here. I have seen 83 Utah specimens, 43 of which were transformed. From New Mexico 3 from Rio Arriba Co. are apparently *nebulosum*. Colorado specimens from Routt Co., Lake Co., Archuleta Co., and San Luis Valley probably are best considered *nebulosum*. Twenty-five adults from northern Arizona represent this form.

Ambystoma tigrinum ***slateri,*** ssp. nov.

1903 *Amblystoma tigrinum* Powers, Amer. Nat., 37: 385; 1907, Zool. Stud. Nebraska Univ., 7 (3): 76 pp., 9 pls.
1934 *Ambystoma tigrinum* Slater, Copeia, 189; 1937, Herpetologica, 1: 81.

Type.—College of Puget Sound 2489, to be deposited in USNM. Collected by Prof. James R. Slater.

Type Locality.—Five miles southeast of Coulee Dam, Grant Co., Washington.

Range.—British Columbia, Alberta, Washington, Oregon, Idaho, Montana, Wyoming, North and South Dakota, Nebraska.

Diagnosis.—A race in which the dark ground color is reduced to a network; typically the light areas have indefinite borders and are whitish.

Remarks.—This race does not meet *californiense*. The only Oregon record is the Dalles, and Sacramento Co., California, is the farthest north recorded for *californiense*. It does meet *nebulosum*, and many specimens are quite difficult to allocate. Most of the Nebraska specimens are definitely intermediate between *slateri* and *mavortium*, having the dark reduced to network, but having yellow spots with definite borders. A number of specimens have been allocated to *slateri* or to *diaboli* purely on the basis of locality. I have seen no indication of intergradation with *tigrinum*, which might be expected in eastern Nebraska and South Dakota as against western Minnesota and western Iowa. Many more adult specimens are needed before precise boundaries can be worked out.

The Washington specimens are almost wholly due to the energy of Prof. Slater. He has very unselfishly insisted that I describe this form and it is a pleasure to associate his name with it.

I have seen 6 Canadian specimens: Edmonton, Alberta; Midway and Summerland, British Columbia.

Twenty-two adult and 77 larval Washington specimens have been examined, from the counties of Stevens, Spokane, Lincoln, Franklin, Chelan, Klickitat, and Grant. Slater writes me that he has seen it from Whitman Co. (recorded as *Dicamptodon ensatus* by Svihla and Svihla, 1933: 126), and from Okanagan Co. (a larva, identified by Svihla as *A. gracile*). In this connection I might note that larval *gracile* has 8 gill rakers on the anterior face of the third arch, larval *t. slateri* has 19. This range in Washington is the entire state east of the Cascades.

From Oregon I have seen a single specimen from The Dalles. The records for *tigrinum* in literature from Portland and Astoria are based on USNM

specimens of *D. ensatus*, that for the "Cascades at 44 north latitude" is based on the USNM type of *gracile*.

From Idaho I have seen 2 adults. One from Latah Co. agrees perfectly with Washington specimens; one from Oneida Co. is aberrant; 15 larvae from "Snake River" are noncommittal. The species has also been recorded from the counties of Kootenai and Bear Lake. One would expect *nebulosum* in southern Idaho.

From Montana I have seen 20 adults and 10 larvae. These agree with Washington specimens. The range covers the state.

From Wyoming I have seen 46 adults and 11 larvae. Most of them are marbled or mottled and agree with the Washington form. Some from the southwest (Uinta Co.) are like *nebulosum* and some from the southeast (Goshen Co.) like *mavortium*. But Summit Co., Utah, specimens are intermediates, and Carbon Co., Wyoming, specimens are definitely *slateri*. The range covers the state.

From North Dakota I have seen 2 (Lostwood and Lidgerwood). A specimen in bad shape from Ft. Berthold is not racially identifiable.

From South Dakota I have seen 8. One from Sioux Falls is quite close to *diaboli*. One of the 8 is a larva.

Nebraska specimens are mostly intermediate between *slateri* and *mavortium*. I have seen 14 transformed and 39 larval specimens. The range covers the state.

Ambystoma tigrinum ***diaboli***, ssp. nov.

1900 *Amblystoma tigrinum* Osborn, Amer. Nat., 34: 551, f. 1–4; 1901, *Ibid.*, 35; 887, f. 1–6 (Kenmore and Amenia, N. Dak.); Young, 1912, Science, 35: 308; 1924, The Life of Devil's Lake: 99 (Devil's Lake, N. Dak.).

1908 *Cryptobranchus allegheniensis* Pope, Bur. Fish. Publ., 634 (Devil's Lake).

TYPE.—Mus. Zool., Univ. Michigan, 50156.

TYPE LOCALITY.—Devil's Lake, North Dakota.

RANGE.—North Dakota (north and east of Altamount Moraine) into Alberta and Saskatchewan.

DIAGNOSIS.—A large (to 312 mm.) race; often neotenous; ground color light olive; markings on dorsum and sides of scattered circular black spots; large larvae with markings of transformed specimens.

REMARKS.—Occasional specimens show the marbled color of the northwestern race. I have seen no indication of intergradation with *tigrinum* but lack material from western Minnesota.

The coloration may be conceived as a very precocious and larval replacement of most of the dark background by light, so that the dark is reduced to dots. Various stages in this can be seen in *tigrinum* (as an age character), especially in the northwestern part of the range. It may also be noted in the transition forms between *mavortium* and the northwestern race.

I have examined 69 adults from North Dakota (10 from Devil's Lake). Kenmore, Steele, and Amenia mark the southwestern border; the northwestern race seems to occur at Lostwood not far from Kenmore, and at Lidgerwood not far from Amenia. Twenty larvae from North Dakota have been examined. From Canada I have seen 18 from Saskatchewan (Balanger Cr.);

Manitoba (Shoal Lake, Boissevain, Winnepeg, Ninetta); Ontario (Ottawa, USNM 13394 sent by Dr. Robert Bell, Apr. 21, 1883). I regard the Ottawa specimen as of very dubious provenance, but it is certainly *diaboli.*

Many specimens are not typical. Devil's Lake, Kenmore and Amenia individuals are typical. As the two latter mark the Altamount Moraine and I think this a convenient boundary I include in *diaboli* specimens from North Dakota which are not *slateri* and which are north of this moraine.

Incertae Sedis

Material from western Kentucky, western Tennessee, Mississippi, eastern Arkansas, Louisiana, and eastern Texas is so scarce that I am unable to make any sound analysis of it. I have seen one from Paducah (USNM), one from Memphis (Malcolm Parker); 2 from "Mississippi" (USNM 3966. *One* specimen was entered on the record book in 1858 with this locality, presented by Shumard. There are now *two*); 2 from Louisiana (Paris 790, "Louisiana"; ANS 1309, "near New Orleans," type of *ingens* Green); 5 from Texas (Corpus Christi, ANS 20947; Dallas, Berlin 9643; Salado near San Antonio, USNM 4082, types of *proserpine*). The type of *episcopus* from Kemper Co., Mississippi, does not seem to be in existence.

The two "Mississippi" specimens are like eastern *tigrinum.* The Memphis, Louisiana, and Corpus Christi specimens *might* be old adults of *tigrinum.* The description of *episcopus,* the Salado types of *proserpine* and the Dallas specimen show a striking reduction of the ground color to scattered dark spots by an increase of yellow. The forms described from this area are:

1831 *Salamandra ingens* Green, Jour. Acad. Nat. Sci. Phila., 6: 254. Near New Orleans. Type ANS 1309.

1850 *Amblystoma episcopus* Baird, *Ibid.* (2), 1: 284, 293. Kemper Co., Mississippi, collected by Clinton Lloyd. Type not known to be in existence.

1852 *Amblystoma proserpine* Baird, Proc. Acad. Nat. Sci. Phila., 6: 173. Salado (4 miles from San Antonio), Texas; and enroute from Montgomery, Mexico.

Six immature specimens from Salado were taken by Clark. Three are now USNM 4082. 4082 A agrees with the figures in Baird (1859: 29, pl. 35, figs. 7–14); the locality is given as Salado River and the name spelled *proserpina.* Nearly full grown specimens from the latter locality were said to have been taken by R. H. Kern. They cannot now be located. The locality Tamaulipas and the collector Dr. Edwards, frequently given for this name, appear to be entirely erroneous. As far as any definite information exists at present, *proserpine* must be based on the Salado specimens.

It is completely impossible to allocate the following name:

1858 *Desmiostoma maculatus* Sager, Penin. Jour. Med., 5: 428, fig. 1. Supposed to be from New Mexico. A larva. Type not known to exist.

As it is probable that three races occur in New Mexico, I cannot identify an unexamined larval specimen of uncertain provenance. It is not *Lacerta maculata* Shaw, 1802.

Some specimens from Arizona and New Mexico with circular yellow spots cannot now be assigned. These include *Ambystoma maculatum* Hallowell, (1858, Journ. Acad. Nat. Sci. Phila. (2), 3: 355, New Mexico), type USNM 14481 collected by McClellan (not *Lacerta maculata* Shaw, 1802).

This form has rather large larvae with 19–20 gill rakers on the anterior face of the third arch, thus differing from *A. t. velasci.* They are separated by desert from *A. t. californiense,* which does not have large larvae. They are separated from *A. t. tigrinum* by *A. t. mavortium.* Specimens thus associated are from Prescott, Ariz., (2); Rio Mimbres near Deming, N.M. (1); Ft. Wingate, N.M., (9); Pescao, N.M., (3); Nutria, N.M., (2). These occupy territory adjoining *nebulosum* on the north, *mavortium* on the east and *velasci* on the south, and grade into all three.

Additional material may improve the situation, but it is questionable whether *californiense* and *velasci* should be separated from *tigrinum,* and should this distinction be dropped, the whole lot could be called *A. t. tigrinum.* Adults are almost indistinguishable, whereas *nebulosum, mavortium, slateri,* and *diaboli* are abundantly different.

Literature Cited

Baird, S. F.
1859 Reptiles of the boundary. U.S. Mex. Bound. Surv., 2, pt. 2, no. [3]: 1–35, pls. 1–41.

Eights, James
1935 The naturalist's every day book for May, 1935. *Zodiak,* 1: 129–132.

Gadow, Hans
1908 Through southern Mexico. Being an account of the travels of a naturalist. Witherby & Co., London: XVI + 527, illus.

Osborn, H. L.
1900 A remarkable axolotl from North Dakota. *Amer. Nat.,* 34: 551–562, figs. 1–4.

Powers, J. H.
1903 The causes of acceleration and retardation in the metamorphosis of Amblystoma tigrinum: a preliminary report. *Amer. Nat.,* 37: 385–410.
1907 Morphological variation and its causes in Amblystoma tigrinum. *Stud. Zool. Lab. Univ. Nebr.,* 7: 197–273, pls. 1–9.

Slater, J. R.
1934 Ambystoma tigrinum in the State of Washington. Copeia, 1934: 189–190.

Stejneger, Leonhard and Thomas Barbour
1917 A check list of North American amphibians and reptiles. Harvard University Press, Cambridge: IV + 125.
1923 *Idem.* Second edition: X + 171.

Svihla, Arthur and R. D. Svihla
1933 Amphibians and reptiles of Whitman County, Washington. Copeia, 1933: 125–128.

Haverford College, Haverford, Pennsylvania.

Notes on Behavior of *Anolis*

By T. K. Ellis

THE green lizard, anole, or American "chameleon," *Anolis carolinensis* Voigt, is found in the coastal region of the southeastern United States, from North Carolina southward through Florida and westward through the gulf region to the Rio Grande, in Texas.

The following notes and photographs were taken on a plantation a few miles north of Charleston, South Carolina. The lizards are abundant there throughout the warmer months and may be seen occasionally on warm days in the winter on buildings, in trees and shrubs, and on garden walls.

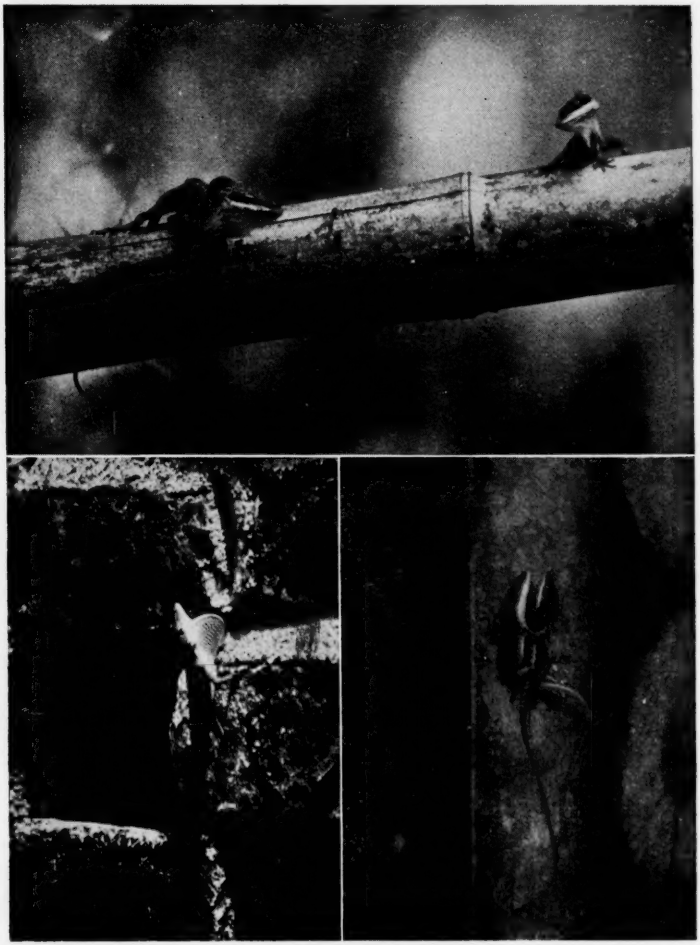

Fig. 1-3. Male anoles preparing to fight, showing raised nuchal crest; male with "blanket" extended; pair of anoles in copulation, male to the left.

Under the throat the skin is rather loose and in the males can be projected into a perfectly flat fan or "blanket" as it is called by the negroes. This "blanket," when fully protruded, is bright red flecked with white spots which are the scales separated by the stretching of the skin. The fan is an ornament always shown at times of love-making or just before and after a battle. If a "chameleon" suddenly starts showing his "blanket," accompanied by violent bobbing up and down of the head and forward part of the body, another lizard is certain to be close by. If in the early part of the summer, and the second animal is a male, very often he too will show his "blanket" and soon a fierce battle will ensue.

After much bobbing up and down with the fan popping in and out the lizards slowly draw closer to each other. When approximately two feet apart a heavy ridge or crest is seen to rise, to a height of nearly a quarter of an inch, on the back of the neck. This nuchal crest extends from the back of the skull to a point midway between the insertion of the front legs, and is pyramidal in cross section. I have not seen any mention of a nuchal crest in this species. It seems to appear only just before and during a fight. Usually the lizards are green in color before going into battle, possibly due to intense excitement, but occasionally they will be brown. As the fight progresses, with the lizards either green or brown at the start, they change to a dirty green on the body with large purplish blotches on the shoulders. The head appears pointed, green in color, and with its intense black and white markings around the jaw, and apparent increase in depth, is grotesque and vicious in appearance. Indeed, one might imagine on seeing one of these lizards ready for battle that he is being given a vision, in miniature, of the appearance of a prehistoric reptile. As the "chameleons" approach each other they very often circle and feint as if waiting for an opportunity to secure a deadly grip. When this moment arrives, in a flash one darts at the other, grabbing him, in those that I have observed, by the shoulder or upper jaw. After this hold is obtained the two lizards thrash about and usually fall to the ground. This generally ends the battle, the force of the fall probably jarring them apart. I have seen them fall from a six foot wall, climb back up, show their "blankets" a few times and go peacefully off. Mr. E. Von S. Dingle of Middleburg says that he once saw two "chameleons" fighting on the top of a forty-five foot chimney. One fell, landed in the grass at the base and apparently unhurt, climbed back to the top of the brickwork.

The mating of this lizard probably has been seldom observed and possibly never photographed. On May 12, 1939, I had that opportunity. As I came around the corner of a cabin on the plantation I saw two on a gutter downspout. The male was intensely green and the female brown with a white streak down the back. Copulation was already in progress and continued for a period of four or five minutes. At the end of this time the reptiles slowly separated and moved apart from each other a distance of about twelve inches. After resting a few minutes both lizards ran along the wall in opposite directions and jumped off into some bushes that were growing near by.

CHARLESTON MUSEUM, CHARLESTON, SOUTH CAROLINA.

Observations on Louisiana Captive Snakes

By George P. Meade

THE section of Louisiana on the Mississippi River between Baton Rouge and New Orleans has a large reptile population embracing a wide variety of species. A casual study of the snakes of the region was started about ten years ago and from this has developed a sizable backyard collection comprising about 150 specimens each summer, most of which are released or given away as cold weather approaches. Certain miscellaneous observations accumulated during the past several years seem worthy of record.

Twenty-one species of snakes have been captured within a radius of 10 miles of Gramercy. Those which are extremely common are:

Farancia abacura reinwardtii
Heterodon contortrix
Lampropeltis getulus holbrookii
Natrix cyclopion cyclopion
Natrix erythrogaster transversa
Natrix r. rhombifera
Natrix sipedon confluens
Thamnophis sirtalis sirtalis

Not present in such large numbers but still commonly represented are:

Coluber constrictor flaviventris
Elaphe obsoleta confinis
Natrix grahamii
Thamnophis saurilus proximus
Agkistrodon piscivorus

Occurring only occasionally are:

Diadophis punctatus stictogenys
Opheodrys aestivus
Lampropeltis triangulum amaura
Natrix rigida
Agkistrodon mokasen mokasen
Sistrurus miliarius streckeri
Crotalus horridus atricaudatus

Juvenile *Elaphe* Feeds on *Anolis*.—Several authorities state that young chicken or rat snakes feed on tree frogs, but none mentions lizards as part of the diet. A young specimen of the blotched chicken snake, *Elaphe obsoleta confinis*, has fed regularly and solely on *Anolis* since it was captured in 1937. The snake was then 15 inches long and has grown to a length of 22 inches. It is in excellent condition, moults regularly, and attacks the lizards promptly whenever these are presented. It is such a ready feeder that motion pictures have been taken of the feedings and several visiting biologists have witnessed the manner in which this snake constricts and swallows its prey. Large specimens of the same species show no interest in *Anolis* even when deprived for many weeks of their usual diet of sparrows or mice.

The Use of the Tail-Spine by *Farancia*.—Various suggestions have been made as to the use which *Farancia* makes of the spine on the tail, but definite statements based on observations have not been found in the literature. The writer has had in his collection at least 125 specimens ranging in size from freshly hatched young to a few examples over 6 feet long, most of the snakes having been kept at least one season. A fact which is believed to be significant and which has apparently not been recorded is that the spine of the larger specimens, 4 feet or more in length, is blunt while that of the smaller snakes is invariably quite sharp. This is so evident that laymen who examine the "horn" or "sting" on the tail of the larger specimens are generally disappointed to find this no sharper than a blunt pencil.

That the spine is used to some extent for protection cannot be denied. The smaller specimens when restrained throw the tail about and attempt to find some soft spot into which to insert the spine, this action being evident even in the case of freshly hatched young, as previously pointed out by the author.[1] Newly captured large specimens when handled seem to resort for protection to sudden and convulsive motions of the body, and the blunt tail-spine is seldom brought into play. Another suggested use for the tail-spine is that the snake when feeding on *Amphiuma* employs it as a sort of "set screw" to hold the slimy amphibian in place. The writer has witnessed more than 300 feedings and has never seen any evidence to support this theory. The snake seizes and holds the amphibian very firmly with its jaws, but the coils of the snake are never able to hold the slippery victim so that the latter's body cannot turn.

A use of the spine which has been definitely observed during feeding is by younger specimens when the amphibian has bitten the snake, particularly near the head. On several occasions under these circumstances the snake has been observed to stab the victim with the spine so sharply as to make the amphibian release its hold. In two or three instances the tail-spine has been seen to inflict deep scratches and draw blood. It would appear from these observations that the younger specimens use the spine as a goad to overcome the mouth-hold which the prey may have on them, while the larger specimens have sufficient bodily strength to break the hold without the use of the spine. In no case has the spine been observed to be used in this way except when the amphibian has bitten and maintained its hold on the snake.

A characteristic action of *Farancia* during feeding is a lengthwise rolling motion of the snake's body, apparently for the purpose of straightening the amphibian, though possibly for some other reason. The prey is frequently swallowed while the snake is still closely coiled, so straightening the victim does not seem to be a necessary part of the feeding.

DEFENSIVE ATTITUDE OF CANEBRAKE RATTLESNAKE TOWARD SPECKLED KING SNAKE.—In an attempt to obtain motion pictures of a fight between a speckled king-snake, *Lampropeltis getulus holbrookii*, and a canebrake rattlesnake, *Crotalus horridus atricaudatus*, it was found that the defense reaction of the rattlesnake was somewhat similar to that described by Cowles[2] for some of the western rattlesnakes in the presence of *L. g. californiae*. The rattlesnakes observed by Cowles (*C. v. oreganus* and *C. cerastes*) are described as forming a broad loop or bend in the body which is lifted from the ground, and the loop is then used as a human being might use an elbow in striking a heavy blow.

In the present instance the specimen of *atricaudatus* was about 33 inches long and the king-snake approximately 4 feet. The rattlesnake was placed in an open-top wire enclosure 5 feet wide by 6 long, and the king-snake introduced afterwards. The rattlesnake immediately flattened the central third of the body, formed this into a bend or half loop, and made convulsive motions sideways on the floor of the cage with this loop. There was no evidence of the loop being raised and brought down sharply by the rattle-

[1] Meade, G. P., 1937. Breeding habits of *Farancia abacura* in captivity. COPEIA, 1937: 12–15, 1 fig.

snake as reported by Cowles, the motion appearing more like a nervous reaction than a defense posture. It is probable that it would have passed unnoticed if the description of the California snakes had not already been read. The king-snake and the rattlesnake seemed afraid of each other and nothing resulted from the encounter.

Motion pictures were also taken of king snakes in the presence of the other two pit-vipers common to this region, *Agkistrodon mokasen* and *A. piscivorus*. The copperhead, a 42 inch specimen, showed no attempt at defense whatever, merely keeping as far away from the king-snake as possible. The cottonmouths, several specimens, did not appear to be afraid of the king-snakes and one specimen struck a king-snake, imbedding its fangs.

Lampropeltis triangulum amaura IN CAPTIVITY.—Conant and Bridges in their recent book *What Snake is That?* say of *L. t. amaura* that "practically nothing is known of the habits of this rather rare snake." It would seem of value, therefore, to report on two specimens which have been in captivity seven years and three years, respectively.

Five examples in all have been in the writer's possession. The first was captured early in the spring of 1932 in the rear of a store in the town of Lutcher, one mile above Gramercy. It was kept about three months, when it escaped. The second was captured in May, 1932, in the same town, but at least a quarter of a mile from the point where the first was taken. From the books available at that time it was thought to be *L. elapsoides* and has always been referred to as a "scarlet king-snake." It has lived for the past seven years in a portable wooden cage about 12″x 12″x 15″, the front and back of which are of glass and the top of wire mesh.

When captured this snake was about 14 inches long, and the light colored bands across the back were an oyster white. It is now 21 inches long and these bands are a light brownish yellow, the effect being as if a transparent brown lacquer had overlaid the white scales. The snout of this specimen, and in fact of all the specimens here described, is not red as generally stated but a grayish black. The appearance of the head is much as if it were covered with black leather slightly worn at the tip. It is to be regretted that some writers have referred to the red snout as the distinguishing mark between the harmless mimics and the true coral snakes. One specimen of *amaura* was killed across the river from Gramercy by a school teacher who was sure it was a coral snake because of the black nose. It was delivered to the writer in alcohol and was the largest and stoutest-bodied of all the snakes here described, being 23 inches long.

In June, 1936, a specimen of *amaura* about 10 inches long was captured at night within 200 feet of the writer's home, and has been kept ever since in the same cage with the one captured in 1932. The earlier specimen was known to be a female, as an undeveloped egg had been laid in 1934. It was hoped that the second might be a male and that mating and eggs would result but nothing like courtship or mating activities have ever been noted, so it has been concluded that both are females. A second undeveloped egg was laid this year but by which snake could not be determined. When captured

[2] Cowles, R. B. Unusual defense postures assumed by rattlesnakes. COPEIA, 1938: 13–16, 1 fig.

the second snake had the oyster-white bands and these still persist as they did for several years in the first specimen before turning brownish yellow. There is a noticeable difference in the under-coloring of the two snakes, the first being oyster-white on the belly except where the black bands continue around the body (being gray-black underneath), whereas the belly of the second specimen is gray-black for the entire length except where the white bands occur. The effect in the first case is of a white-bellied snake with occasional gray-black cross markings and in the second case of a gray-black belly with occasional white cross markings. Another difference in pattern is that the red bands on the back of the older snake are much wider, seven scales as against four or five scales in the younger.

Both specimens feed readily on *Anolis*, which are plentiful here, but it has been found best to separate them during feeding. The older snake is not disturbed by the presence of an audience, and moving pictures have been taken of it swallowing a lizard. The prey is usually constricted and killed before swallowing, the snake releasing its mouth-hold until the lizard ceases to struggle, but if the lizard is seized by the head the swallowing proceeds without constriction. A record has been kept since March 25 of this year for the older snake and up to September 8 twenty-five lizards had been eaten.

A record of moulting kept for this snake during the same period shows that it has shed eight times in five and a half months. For the summer months (June 11 to September 8) shedding has occurred regularly every twenty days. In its seven years in captivity this snake has never experienced any difficulty in freeing itself of its skin, which is invariably shed entire. It has never been seen to soak itself in the water dish, although this is a regular custom of the younger snake.

It may be added that these two snakes have lived under indoor conditions, as their cage is kept in the house summer and winter. They feed occasionally during the winter, not oftener than once a month from November to March, during which time they are in a cool pantry away from steam heat. They spend most of their time in a brown cardboard box in their cage into which is stuffed a flannel cloth in the winter months.

A small specimen, apparently freshly hatched, was captured in August, 1937, the brilliant pattern being most striking in this 5 inch snake. The fifth example, about 12 inches long, was caught in the spring of 1938, both these snakes being donated to private collectors. From the varying sizes of these different specimens it may be inferred that the older captive was at least two years old when first caught, which would make it nine years old at present.

GRAMERCY, LOUISIANA.

A List of the Reptiles of Washington

By Robert P. Owen

THIS survey includes the distributional information gathered through three seasons of collecting, plus a summary of the literature on the herpetology of Washington. I hope to publish an exhaustive report on the reptiles of the state at a later date.

The state of Washington is divided longitudinally by the high Cascade Mountains, with about two-thirds of the state on the east side and one-third on the west side of this range. The two sides are totaliy different in their flora, and differ to a lesser extent in their fauna. The mountains are a definite barrier to the majority of the vertebrates. The west side is very humid, and covered with dense forests (Douglas fir); there are only a few isolated open prairies, the result of soil conditions rather than lack of rainfall. Eastern Washington is more varied. Except for the forests in the high Cascades, the forests of eastern Washington are principally of yellow pine (*Pinus ponderosa*), more open and with little or no underbrush. These forests occur on the east slope of the Cascades, the Okanogan highlands, and in the northeastern part of the state bordering on Idaho and British Columbia. The remaining greater part of the eastern section is covered with sagebrush desert and bunchgrass, with isolated forests like those in the Simcoe and Blue Mountains.

List of Species

Uta stansburiana stansburiana (Baird and Girard).—Not previously recorded from Washington. I have found this lizard plentiful, and have collected it from as far north as Vantage, Kittitas County, on both sides of the Columbia River. It was not found farther north along the Columbia at Wenatchee, Chelan County. It is quite probable that this lizard has only recently invaded the state, for it is too plentiful to have escaped the notice of earlier naturalists. According to Walter W. Dalquest, of the University of Washington, several years ago only *Sceloporus graciosus gracilis* was found on the Columbia River near Vantage, whereas in the summer of 1938 this *Sceloporus* could not be found except on the plateau above and several miles back from the river. The *Uta* have evidently displaced *Sceloporus*.

Sceloporus graciosus gracilis (Baird and Girard).—This swift seems to be confined to the sagebrush and desert country of eastern Washington. I have taken it at Pomona, Yakima County; Wallula, Walla Walla County; Neppel, Grant County; and near Vantage, Grant County; and have seen it near Wenatchee, Chelan County. Recorded by Dice (1916) from Columbia County. Van Denburgh (1922) mentions records from Kelso, Cowlitz County, and near Puget Sound in western Washington, but I doubt the authenticity of these records.

Van Denburgh records *S. g. graciosus* from Washington, but gives no locality records. This form is therefore omitted from the present list.

Sceloporus occidentalis occidentalis (Baird and Girard).—In my own collection there is only one representative of this subspecies, collected by W. W. Dalquest, in Pierce County. The only other locality records that I

can find are Cape Flattery, Clallam County; Port Townsend, Jefferson County; and Fort Steilacoom, Pierce County, all in western Washington (Van Denburgh, 1922).

Sceloporus occidentalis biseriatus (Hallowell).—Not previously recorded from the state. Fairly common in the rocky and forested regions of eastern Washington where *Pinus ponderosa* occurs. I have specimens from Simcoe Mountains, Yakima County (collected by W. W. Dalquest); Peshastin and Mission creeks, Chelan County; Beaver Lake, Okanogan County; and White Salmon, Klickitat County. The specimen from White Salmon seems to be an intergrade between *S. o. biseriatus* and *S. o. occidentalis*.

Phrynosoma douglassii douglassii (Bell).—This lizard will probably eventually be recorded from all the desert and sagebrush country of eastern Washington. My specimens are from Ellensburg, Kittitas County; Pateros, Okanogon County; and Selah, Yakima County. I have seen it at Moses Lake, Grant County; and Mansfield, Douglas County. Dice records it from Walla Walla and Columbia counties; Svihla and Svihla (1933) from Whitman County; and Blanchard (1921) from Stevens County. Van Denburgh includes a record from Fort Steilacoom, which, if it can be verified, will extend the range to western Washington.

Phrynosoma platyrhinos Girard.—Recorded by Yarrow and Cope from Walla Walla. This is the only record that I know of for this lizard in Washington, but it is probably authentic.

Gerrhonotus coeruleus principis (Baird and Girard).—Rather common in western Washington. Van Denburgh records it from Easton, Kittitas County, and from Stevens County, both in eastern Washington. I have collected one specimen from eastern Washington, at Beaver Lake, Okanogan County. The rest of my specimens are from Seattle.

Gerrhonotus multicarinatus scincicauda (Skilton).—The one specimen in my collection was taken at Roosevelt, Klickitat County. Recorded by Van Denburgh from Klickitat County along the Columbia River opposite the John Day River of Oregon. It has been recorded only from this county.

Eumeces skiltonianus skiltonianus (Baird and Girard).—Probably ranges throughout the forested sections of eastern Washington. I have no specimens in my collection, but have seen it at Dryden, Chelan County, and at Brewster, Okanogan County, and have seen specimens from Dry Falls, Grant County, and Toppenish, Yakima County. Van Denburgh records it from Pullman.

Charina bottae (Blainville).—Recorded from the forested regions of eastern Washington. I have collected it only in Chelan County. Dice records it from Walla Walla and Columbia counties, and Svihla and Svihla from Whitman County. I have seen one specimen in western Washington, close to the summit of the Cascade Mountains on Ruby Creek, Whatcom County. It is quite possible that it occurs all along the west slope of the Cascades, but it is not likely to be found on the Olympic Peninsula.

Diadophis amabilis occidentalis Blanchard.—Three specimens of this small snake have recently been reported from this state by Svihla (1938), who recorded it from Wawawai, and Colfax, Whitman County; and Klama,

Cowlitz County. Thus the range of this snake may be said to be the southern part of the state on both sides of the Cascade Mountains.

Coluber constrictor mormon (Baird and Girard).—Fairly evenly distributed in both the forests and sagebrush regions of eastern Washington. It has been recorded once from the Tacoma prairies in western Washington (Alcorn, 1935). I have collected it at War Creek and Pateros, Okanogan County; Kenniwick, Benton County; Dry Falls, Grant County; and Peshastin Creek, Chelan County.

Pituophis catenifer catenifer (Blainville).—This snake seems to prefer the pine forests of eastern Washington. I have taken it at Peshastin Creek, Chelan County; Brewster, Douglas County; and Cle Elum, Kittitas County. Other records include many counties in eastern Washington. It has also been recorded from western Washington at Puget Sound, and at Fort Steilacoom, Pierce County (Van Denburgh).

Pituophis catenifer deserticola Stejneger.—I have taken this species at Wallula, Walla Walla County; Kenniwick, Benton County; and Trinidad, Grant County. Svihla and Svihla record it from Whitman County. It apparently occurs throughout the dry sagebrush and desert regions of eastern Washington.

Contia tenuis (Baird and Girard).—Recorded by Van Denburgh from Puget Sound. This species has not been found for many years.

Thamnophis ordinoides ordinoides (Baird and Girard).—This snake is very common throughout all of western Washington, and is exceedingly variable as to color pattern, scale counts, etc. I have specimens from Seattle and Carnation; King County; Bellingham, Whatcom County; Ocean Park, Pacific County; and Friday Harbor, San Juan County.

Thamnophis ordinoides biscutatus (Cope).—Also found throughout the western part of the state, although less abundant than *T. o. ordinoides*. All of my specimens are from Seattle.

Thamnophis ordinoides vagrans (Baird and Girard).—Ranges throughout eastern Washington, especially around lakes and streams, and is abundant only locally. My specimens are from the Palouse River, Whitman County; Methow River and Beaver Lake, Okanogan County; and Lake Wenatchee, Chelan County. Those from Methow River were taken from a rattlesnake den.

Thamnophis sirtalis concinnus (Hallowell).—Ranges throughout western Washington. My specimens are from Seattle and Stevens Pass, King County; Bellingham, Whatcom County; and Ocean Park, Pacific County. This form is less common than the garter snakes of the *ordinoides* group, but more abundant about streams and lakes.

Thamnophis sirtalis parietalis (Say).—I agree with Ruthven (1908) that the *sirtalis* found in eastern Washington represents this subspecies. Ventral scale counts are higher and more consistently uniform than those of the *sirtalis* of western Washington and coloration is lighter and less variable. Judging from previous records and from specimens in my own collection, it ranges throughout eastern Washington, more particularly about streams and lakes. It will be necessary to compare my specimens with those in other collections to determine positively the proper allocation of *sirtalis* from eastern Washington.

My specimens are from Dry Falls, Grant County; and Beaver Lake, Okanogan County. Blanchard records it from Stevens County, and Svihla and Svihla from Whitman County under *T. s. concinnus*.

Hypsiglena ochrorhynchus (Cope).—This snake was found near Vantage, Grant County, by Svihla in the spring of 1939. This is an unusual record since it was not previously known to occur north of southern Idaho.

Crotalus viridis oreganus (Holbrook).—This is the only rattlesnake so far recorded within the boundaries of the state. With the exception of deep forests, it ranges over the whole of eastern Washington. My specimens are from War Creek and Pateros, Okanogan County; Vantage and Euphrata, Grant County; and Brewster, Douglas County.

Chrysemys bellii bellii (Gray). Previously recorded from only a few lakes and rivers in the state. I have found and collected it in the Palouse and Okanogan rivers, and in Moses Lake and the pothole region south of this lake, Grant County. It probably occurs throughout all of eastern Washington in the slower streams and rivers and in the lakes of the Upper Sonoran Zone. Dice records it from Walla Walla and Columbia counties, and Blanchard from Stevens County. I have collected it in Lake Washington and Lake Sammamish, in western Washington. Turtles of this species found in the western part of the state have undoubtedly been transplanted from the east.

Clemmys marmorata (Baird and Girard).—Apparently this turtle formerly occurred in the lakes of southwestern Washington. It has not been found for a period of ten years in the state, although it may still exist.

It is probable that some member of the family Cheloniidae will eventually be added to the fauna of the state, as I have learned from fishermen that large sea turtles have been taken from halibut nets in the San Juan Islands.

Literature Cited

Alcorn, G. D.
1935 The western yellow-bellied racers in western Washington. Copeia, 1935: 103.

Blanchard, F. N.
1921 A collection of amphibians and reptiles from northeastern Washington. Copeia, 90: 5–6.

Dice, L. R.
1916 Distribution of the land vertebrates of southeastern Washington. *Univ. Calif. Publ. Zool.*, 16: 293–342, pl. 24–26.

Ruthven, A. G.
1908 Variations and genetic relationships of the garter snakes. *Bull. U. S. Nation. Mus.*, 61: xii+201, 82 figs., 1 pl.

Svihla, Arthur
1938 Occurrence of the ring-necked snake in the state of Washington. Copeia, 1938: 47.

Svihla, Arthur, and R. D. Svihla
1933 Amphibians and reptiles from Whitman County, Washington. Copeia, 1933: 125–128.

Van Denburgh, John
1922 The reptiles of western North America. *Occ. Pap. Calif. Acad. Sci.*, 10: 1–1028, 128 pls.

Seattle, Washington.

The Perciform Genera *Gymnapogon* and *Nannatherina*

By C. Tate Regan

GYMNAPOGON japonicus, a new genus and species of fishes, was described by me in 1905 (Regan, Ann. Mag. Nat. Hist., (7) 15: 19) from a number of specimens measuring up to 45 mm. in total length, from the Inland Sea of Japan. I considered it to belong to the Chilodipteridae (=Apogonidae), and using Jordan and Snyder's review of the Japanese fishes of this family (Proc. U. S. Nat. Mus., 22, 1901: 891–913), I put it near *Telescopias*, which it appeared to resemble in having the spines feeble, canines anterior in the upper jaw, and lateral in the lower, preoperculum produced into a thin flap, etc.

In 1913 (Classification of the Percoid Fishes, Ann. Mag. Nat. Hist., (8) 12: 111–145) *Telescopias*, as a synonym of *Scombrops*, was placed in the Pomatomidae, and *Gymnapogon* was mentioned as related to it. I have for some time thought it likely that this was a mistake, but it was not until I had read Herre's description of *Henicichthys philippinus* (Copeia (4), 1939: 200), evidently a *Gymnapogon*, that I decided to reexamine the types, and to study the skeleton. This I have done by examining an alizarin preparation and by dissecting another specimen.

Henicichthys foraminosus Tanaka, 1915 (Tomiyama, Japanese J. Zool., 7 (1), 1936: 50, fig. 9) is a synonym of *Gymnapogon japonicus*. Tomiyama's figure is good, except that the pectoral fin is too high, and the caudal rays are too divergent. He considers this fish to be a gobioid, but it differs from all known members of this group in having the gill membranes separate and two anal spines, and I find that the skeleton is typically perciform.

In most respects *Gymnapogon japonicus* resembles the Chilodipteridae, especially *Chilodipterus*, but it differs from them in the following characters:

No scales; sides of head with a network of series of small pores; 20 or more vertical series of similar pores on each side of body; lateral line represented by a series ending below soft dorsal, and another on middle of side of tail. Fin spines very slender. Pectoral higher, the upper end of its base about equidistant from dorsal and ventral profiles. Operculum connected by membrane to pectoral arch, the gill opening ending a little above the pectoral. No supramaxillary (or supplemental maxillary).

There appear to be no other differences from the Chilodipteridae. The dentition is similar to that of *Dinolestes* and *Synagrops*. The preoperculum, produced backwards below as a large thin flap, is also much as in these genera. The dorsal fin has VI, I 10-11 rays, the anal II 9–10. The caudal has 17 principal rays, 15 branched, and a series of about 10 procurrent simple rays above and below, a structure approached in *Synagrops*. The pelvics, with I, 5 rays, are close together, a little in advance of the pectorals, which have 13 or 14 rays.

The pectoral fin is supported by four hour-glass shaped radials. The skull is essentially similar to that of *Dinolestes*, as described by Starks (Proc. U. S. Nat. Mus., 12, 1899: 113–120, pls. VIII–XI), but with parietal crests scarcely developed, and with a short ethmoid region, ending

just in front of the lateral ethmoid projections. The vertebrae number 25 (10+15), the precaudals with divergent parapophyses from the fifth to the last. The hypurals are fused to form a pair of plates, divided by a median fissure (nearly as in *Synagrops*).

In the Pomatomidae (*Pomatomus, Scombrops*) the parapophyses of the posterior precaudal vertebrae are downwardly directed, parallel; the supramaxillary has a projection from its upper edge, and there are three anal spines, the first sometimes concealed. In the Chilodipteridae the parapophyses are divergent, the supramaxillary is slender, without projection, and there are two anal spines. *Gymnapogon* resembles the Pomatomidae rather than the Chilodipteridae only in having the fin spines feeble. Its relationship to the Chilodipteridae is evident, and I am inclined to place it in that family, but as the type of a separate subfamily. I have compared it with *Champsodon*, which also has vertical series of pores, but is very much different in other respects.

Nannatherina balstoni Regan (Ann. Mag. Nat. Hist., (7) 18, 1906: 451) was described from two specimens, 50 mm. long, from the King River, western Australia, and was placed in the Atherinidae, although it was noted that the connected dorsals and rather low pectorals were not typical of that family. In *Nannatherina* the pelvic bones are remote from the cleithra and connected to them by a rather long ligament, and there is no lateral line; but in other respects this genus seems to be nearer to *Kuhlia* than to *Atherina*. In *Kuhlia* the pelvic bones are in contact and taper to an acute point, which is just behind the cleithra; dissection of spirit specimens shows that the anterior part is enclosed in a fibrous sheath, continued forward as a short stout ligament attached to the cleithra. The difference from *Nannatherina* is one of degree. The head skeleton of *Nannatherina* is essentially similar to that of *Kuhlia* (cf. Boulenger, Cat. Fishes, 1, 1895: 35, fig. 4). *Nannatherina* is distinguished by the rather large (30) cycloid scales, the absence of a lateral line, and the remoteness of the pelvic bones from the pectoral arch. The dorsal, subdivided by a notch, has IX–X, 8–9 rays, the anal III, 8–9; the vertebrae number 31 (14+17). I now place this genus in the Kuhliidae.

The differences in skull structure between the Chilodipteridae and Kuhliidae would be considered of only generic importance in the Serranidae. In both families the dorsal profile of the head is defined by the premaxillary pedicels, the frontals, and the edge of the supraoccipital crest. In the Chilodipteridae the region immediately behind the frontals is formed in the middle by an oblong platform on or nearly on the same level as the frontals, and on each side by a large open temporal fossa, the floor of which is formed mainly by the pterotic. The bones of the platform are, in the middle, the anterior part of the supraoccipital, without or with a low crest, and on each side, parietal in front and epiotic behind; the parietal crest, if developed, is feeble, at the junction between the horizontal part of the bone adjacent to the supraoccipital and the vertical part that forms the inner wall of the temporal fossa. Behind this platform is the posterior face of the skull, with high occipital crest.

The Kuhliidae differ in that the parietals are divided transversely into anterior parts on a level with the frontals, and posterior that join the

epiotics, but whose upper surfaces descend backward to such an extent that they may be considered to belong to the posterior surface of the skull. The supraoccipital also has a short anterior region, without crest, on a level with the frontals; behind this it descends, and has a crest that rapidly increases in height.

BRITISH MUSEUM (NATURAL HISTORY), LONDON, ENGLAND.

Occurrence of the Blue-breasted Darter, *Nothonotus camurum* (Cope), in Illinois[1]

By CLARENCE J. GOODNIGHT and BERTRAND A. WRIGHT

THE blue-breasted darter *Nothonotus camurum* (Cope), is considered one of the rarest of Illinois fishes. It is apparently restricted to the swiftest waters and even here it is far out-numbered by other species. Jordan and Evermann (1896) say that it occurs from "Indiana and Ohio to Tennessee in clear, swift water; not common."

This species has been reported for Illinois by Large in 1903. He makes the following comment: "Early collections of this species appear from Peoria, from Union County, and from the Saline and lower Wabash basins." However Forbes and Richardson (1908), in their report on the fishes of Illinois, say "it is not now represented in our collections. A single specimen thought to belong to this species was presented to this laboratory by Mr. J. P. Bauer, of the United States Fish Commission, who took it from a pond near Naples, Illinois, but it was unfortunately lost before preliminary identification could be verified."

In view of the facts above, it was with surprise that the writers, while darter seining in the rapids of the Salt Fork River a few miles south of Oakwood, Illinois, obtained specimens of this rare fish. The preliminary identification of the writers was later checked by Dr. David H. Thompson of the Illinois State Natural History Survey who stated that he had taken a few specimens in the same locality some time ago. These collections were cited by O'Donnell (1935).

The first specimen was collected on November 6, 1939. The specimen, a male, measured 2½ inches standard length and was profusely marked with bright rust-orange spots on the sides. The ventral portion in the region of the pectoral fins was a brilliant turquoise blue. On November 13, the writers caught sixteen more specimens in a rapids slightly above the place where

[1] Contribution from the Zoological Laboratory of the University of Illinois, No. 550.

they had caught the specimen of the previous week. At this spot the river is only about 10 feet wide and from 1 to 2 feet deep. The current is extremely swift in this section, more so that at any other point in the vicinity. The bottom is covered by rocks ranging in size from 6 inches to 2 feet in diameter.

It was noticed that this darter, in particular, seemed to take refuge behind large stones. Because of this habit ordinary seining methods could not be employed. It was necessary to dislodge the rocks and drive the darters into the net. This peculiar hiding habit may be a factor accounting for the infrequency with which they are taken.

In these same rapids several other species of darters were found, including the greensided darter, *Etheostoma blennioides* Rafinesque, the sharp-nosed darter, *Hadropterus phoxocephalus* (Nelson), the rainbow darter, *Poecilichthys caeruleus* (Storer), the black-sided darter, *Hadropterus maculatus* Girard, Johnny darter, *Bolesoma nigrum* (Rafinesque), and the fan-tailed darter, *Catonotus flabellaris* (Rafinesque).

The blue-breasted darters were brought into the laboratory and placed in an aquarium which was constantly aerated. It was found that the fish were well able to survive at room temperature if air was bubbled through the water continuously. While the fish were in the laboratory they were fed on plankton. It is interesting to note that Jordan and Evermann (1896) quoting from Jordan and Copeland state that this darter never survived more than two or three hours in captivity. The specimens collected by the writers during the first weeks of November remained healthy until the first week of February, 1940, when they were all killed by an unfortunate accident. It is the belief of the writers that if the initial shock of change from natural to artificial conditions is overcome, the chances of survival are considerably increased.

The standard lengths of the seventeen specimens caught in Salt Fork River are given below:

Size Class	Number of Specimens
1.50 inches	2
1.75 inches	3
2.00 inches	3
2.15 inches	2
2.25 inches	5
2.50 inches	2
Total	17

Literature Cited

Cope, E. D.
1870 On some Etheostomine perch from Tennessee and North Carolina. *Proc. Amer. Philos. Soc. Phila.*, 11: 265.

Forbes, S. A. and R. E. Richardson
1908 The fishes of Illinois. *Ill. Lab. Nat. Hist. Rept.*, 3: 306.

Jordan, D. S. and B. W. Evermann
1896 The fishes of North and Middle America. *Bull. U. S. Nat. Mus.*, 47: 1076.

Large, T.
1903 A list of the native fishes of Illinois, with keys. *Rept. State Board Fish Comm.*, from Sept. 30, 1900, to Oct. 1, 1902: 28.

O'Donnell, D. J.
1935 Annotated list of the fishes of Illinois. *Ill. Nat. Hist. Surv. Bull.*, 20: 489.

Dept. of Zoology, University of Illinois, Urbana, Illinois.

The Rate of Growth of the Northern Pike, *Esox lucius* Linnaeus, in Wisconsin Waters[1]

By Willard A. Van Engel

Introduction

WITHIN recent years the trend in fishery biology has been toward fish management, with particular emphasis on lake improvement. Construction and artificial fertilization of lakes and ponds and selected planting of various species of fish are giving investigators some idea of the specific requirements of each species. To make an analysis of the influence of various factors in the environment upon its fish population, it is necessary to study the rate of growth of a species in one environment, and then to make comparisons with the same species under another set of conditions.

Through the cooperation of the Wisconsin Conservation Department, the U. S. Fish and Wildlife Service, and the Wisconsin Geological and Natural History Survey, requests for scales and measurement data from anglers of the state have resulted in the accumulation of material for a number of gamefish growth studies. Reports of the Limnological Laboratory have already been published on the large and small mouth black bass (Bennett, 1937, 1938), and the muskellunge (Schloemer, 1936, 1938), while material is still being collected for a study of the wall-eyed pike. The relatively slow accumulation of scale samples of the northern pike since 1927 has finally produced sufficient material to warrant a growth study of the species. Scales and data of the northern pike from the collection of the Illinois Natural History Survey have been placed at our disposal for comparison of the growth rate in the two states. The terms northern pike and pickerel will be used synonymously in this report.

Distribution of Age Groups

Figure 1 demonstrates a distribution of the frequencies of the age groups 0 to XIII. The maximum age for the species, age group XIII (in the fourteenth year of life), is represented by only one specimen. The greatest returns from anglers are from age groups II, III, and IV, or 62 per cent of the total number. Age groups I through VI make up 89 per cent of the returns.

The oldest specimen represented in the collection, 14 years, weighed 22 pounds, was 46.9 inches long (total length), and was caught near Rhinelander in October, 1930. The longest specimen measured 47.5 inches, was in its twelfth year of life, weighed 15 pounds, and was caught in Lake Delta, Bayfield County, in 1936. The heaviest specimen weighed 30 pounds, was 39 inches long, was in its tenth year of life, and was caught in Spring Lake, Washburn County, in 1928. The world record northern pike, reported by Gordon Mac Quarrie in the Milwaukee Journal, February 20, 1938, and authenticated by the American Museum of Natural History, was 45 pounds 12 ounces in weight.

[1] From the Limnological Laboratory of the Wisconsin Geological and Natural History Survey. Notes and reports No. 94. This study was financed by the Wisconsin Conservation Department, Madison, Wis. Published with the permission of the Director, United States Fish and Wildlife Service.

Ratio of Standard to Total Length

Since the length data supplied by fishermen were either in standard or total length in inches or millimeters, it was necessary to determine the ratio of the two length measurements, so that calculated lengths could be compared in consistent units. From the data of 41 specimens, representing 8 Wisconsin lakes, ratios varying from 1 : 1.071 to 1 : 1.146 were obtained. A weighted average of these figures resolved into a ratio of 1 : 1.13, and this ratio was used throughout in all calculations.

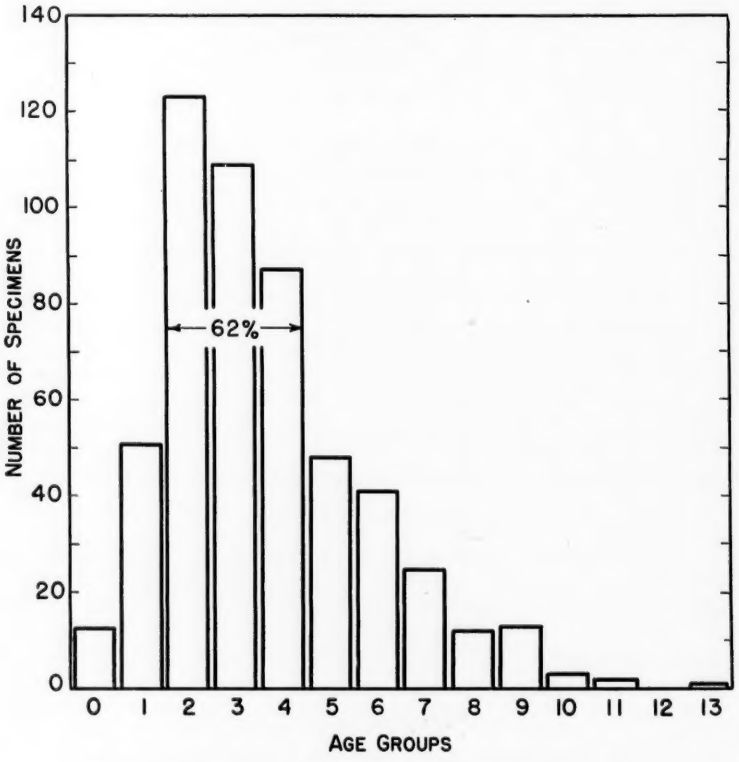

Fig. 1. Frequency distribution of 528 Wisconsin northern pike.

Rate of Growth

The analysis of the growth in length is based on age determinations and the measurements of scales of 515 specimens from 98 lakes and 9 rivers of the state. Of the data of 550 northern pike from Wisconsin, 22 (4 per cent) were not used in this study because of regenerated scales or insufficient data, and 13, collected by workers at the Trout Lake Limnological Laboratory, represent the 0 age group, leaving only the

data from 515 specimens on which to base the analysis of growth. The number of specimens from any one body of water ranges from 1 to 64. Since there are differences in these bodies of water—in the length of the growing season, physical and chemical factors, density of population, parasitism, availability of food, etc.—which influence the rate of growth, it must be recognized that we are working with a mass of heterogeneous material and therefore the general growth curve is an approximate average of the existing conditions and not necessarily the actual course of growth of an individual.

TABLE 1

AVERAGE ACTUAL AND CALCULATED TOTAL LENGTHS OF VARIOUS AGE GROUPS OF ALL WISCONSIN NORTHERN PIKE

Age group	Average actual length	Frequency	Average calculated total length in inches												
			1	2	3	4	5	6	7	8	9	10	11	12	13
XIII	46.9	1	10.6	16.9	24.1	28.4	32.5	35.3	38.8	40.6	42.6	44.4	45.6	46.0	46.4
XII	....	0	....	....	....	....	....	....	....	....	....	....	....	....	....
XI	44.8	2	9.4	17.0	23.4	27.5	31.3	34.7	37.0	39.0	41.2	42.8	44.0	....	....
X	44.3	3	13.9	22.5	28.9	33.3	36.9	38.9	40.8	42.0	43.1	43.9	....	....	....
IX	39.6	13	10.5	19.7	25.7	29.6	32.7	35.1	36.8	38.1	39.0	....	....	....	....
VIII	37.3	12	12.6	22.0	27.3	30.3	32.5	34.4	35.7	36.8	....	....	....	....	....
VII	35.0	25	9.4	19.9	25.3	28.7	31.3	32.8	34.0	....	....	....	....	....	....
VI	31.6	41	9.5	18.1	23.3	27.0	29.4	30.9	....	....	....	....	....	....	....
V	29.2	48	9.5	17.8	23.0	26.3	28.2	....	....	....	....	....	....	....	....
IV	27.0	87	9.6	17.6	22.7	25.7	....	....	....	....	....	....	....	....	....
III	23.4	109	9.8	17.7	21.8	....	....	....	....	....	....	....	....	....	....
II	21.5	123	10.5	18.6	....	....	....	....	....	....	....	....	....	....	....
I	19.9	51	11.5	....	....	....	....	....	....	....	....	....	....	....	....
0	11.1	13	....	....	....	....	....	....	....	....	....	....	....	....	....
Frequency	.....	528	515	464	341	232	145	97	56	31	19	6	3	1	1
Average length.	.....	.....	10.1	18.3	23.0	26.9	30.1	32.8	35.6	38.1	40.0	43.6	44.6	46.0	46.4

TABLE 2

AVERAGE CALCULATED TOTAL LENGTHS OF VARIOUS AGE GROUPS OF NORTHERN PIKE FROM LAKE MENDOTA, DANE COUNTY

Age group	Frequency	Average calculated total length in inches								
		1	2	3	4	5	6	7	8	9
IX	1	8.7	20.2	26.7	32.1	35.5	37.2	37.8	38.4	38.9
VIII	4	15.7	27.0	33.2	35.5	36.9	38.2	38.7	39.3	.....
VII	3	11.4	24.5	29.3	32.4	34.3	35.8	36.9	.....	.....
VI	4	11.9	22.6	28.2	31.1	33.2	34.6	.....	.....	.....
V	6	11.6	21.3	26.9	29.7	31.3	.....	.....	.....	.....
IV	13	11.3	20.4	25.4	28.0	.....	.....	.....	.....	.....
III	6	11.4	20.9	24.2	.....	.....	.....	.....	.....	.....
II	13	10.2	19.7	.....	.....	.....	.....	.....	.....	.....
I	14	11.3	.....	.....	.....	.....	.....	.....	.....	.....
Frequency	64	64	50	37	31	18	12	8	5	1
Average length....	.....	11.4	21.3	26.9	30.3	33.7	36.3	37.9	39.1	38.9

Growth calculations in Table 1 show the variations in calculated total length for each year of life of the various age groups. It is immediately evident from the table that Lee's phenomenon of the apparent decrease

in the calculated length as it is determined from successively older age groups does not seem to hold for this species; in fact, there is a definite tendency for an increase in the calculated length. However, an examination of the data of individual lakes indicates the presence of Lee's phenomenon in the calculated lengths for all age groups of Lake Delta (Table 4), but only in the calculated lengths for the first year of life in Lake Mendota (Table 2) and in Sturgeon Bay (Table 3). In the older years of life in the latter two lakes, Lee's phenomenon is non-existent.

TABLE 3
AVERAGE CALCULATED TOTAL LENGTHS OF VARIOUS AGE GROUPS OF NORTHERN PIKE FROM STURGEON BAY

Age group	Frequency	Average calculated total length in inches								
		1	2	3	4	5	6	7	8	9
VII	3	7.0	18.5	24.3	27.5	30.4	31.6	32.6	.....	.....
VI	4	6.8	16.1	23.6	28.0	30.0	31.1	.....	.....	.....
V	4	6.6	16.5	23.7	27.1	28.6	.....	.....	.....	.....
IV	4	8.1	16.1	22.1	24.2	.....	.....	.....	.....	.....
III	8	6.4	15.6	22.2	.....	.....	.....	.....	.....	.....
II	5	9.1	19.4	.....	.....	.....	.....	.....	.....	.....
I	3	9.7	.....	.....	.....	.....	.....	.....	.....	.....
Frequency	31	31	28	23	15	11	7	3	.....	.....
Average length	.....	7.5	16.9	23.0	26.6	29.6	31.3	32.6	.....	.....

TABLE 4
AVERAGE CALCULATED TOTAL LENGTHS OF VARIOUS AGE GROUPS OF NORTHERN PIKE FROM DELTA LAKE, BAYFIELD COUNTY

Age group	Frequency	Average calculated total length in inches								
		1	2	3	4	5	6	7	8	9
VIII	2	7.8	14.5	18.6	21.1	23.6	26.3	28.3	30.2	.....
VII	2	8.4	16.0	20.1	22.4	25.1	27.5	28.9	.....	.....
VI	5	7.1	14.5	19.0	21.6	24.4	26.0	.....	.....	.....
V	9	8.5	15.4	19.5	22.8	25.2	.....	.....	.....	.....
IV	12	8.4	16.1	20.8	23.9	.....	.....	.....	.....	.....
III	7	8.0	15.5	19.5	.....	.....	.....	.....	.....	.....
II	2	10.5	18.9	.....	.....	.....	.....	.....	.....	.....
Frequency	39	39	39	37	30	18	9	4	2	.....
Average length	.....	8.3	15.7	19.8	22.9	24.8	26.4	28.6	30.2	.....

The accuracy of the assessment of age and of the application of the body-scale ratio to the calculation of growth during the various years of the life of the individual can be determined by a comparison of the average actual lengths at the time of capture with the average calculated lengths (Table 1). Since the average actual length of an age group represents a length attained sometime during the growing season, after the formation of an annulus, it should be greater than the length which is calculated to the last formed annulus.

Average calculated lengths of age groups I to IV inclusive and X to XIII inclusive agree favorably with average actual lengths for the same

years of life. The observed large average for age group I is due to the capture of only those fast-growing pickerel which have exceeded the legal length of 18 inches before the end of the second year of life. In the other groups a discrepancy is observed: calculated lengths from the fifth through the ninth years of life show better agreement with actual lengths of age groups IV to VIII than with actual lengths of age groups V to IX. This may be interpreted on the basis of the observed disagreement with Lee's phenomenon—to the apparent increase in the calculated length—and may be attributed either to changes in the growth relation between body and scale with change in age, or to selection due to differential mortality. Since the faster growing individuals of a population have been shown to have a tendency to a shorter life span, their high growth rate would have an increasing effect on the calculated lengths, as in the age groups V to IX inclusive.

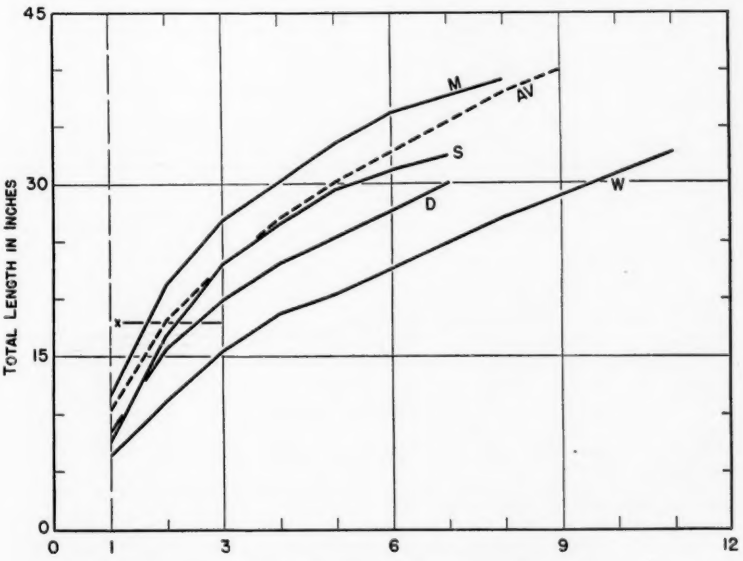

Figure 2. Comparative growth in length of northern pike.
M, Mendota; S, Sturgeon Bay; D, Delta; W, Waskesiu; AV., average of all Wisconsin lakes; x, the legal length.

The growth curves of Figure 2 were derived from the data of Tables 1, 2, 3, and 4. Since differences in the length of the growing season have been reported to be important contributing factors toward differences in growth rates in the cisco (Hile, 1936), it was thought that a similar conclusion might be drawn from a comparison of northern pike taken from lakes in various latitudes of the state. However, no data are at hand on the lengths of the growing seasons in these lakes, and so these growth curves must be compared only on the assumption that the latitude

in some way reflects the length of the growing season. The additional data on the northern pike from Waskesiu Lake, Prince Albert National Park, northern Saskatchewan (Rawson, 1932), adds much to the comparison. It is strikingly evident that the rate of growth is greatest in the lower latitude and least in the higher latitude.

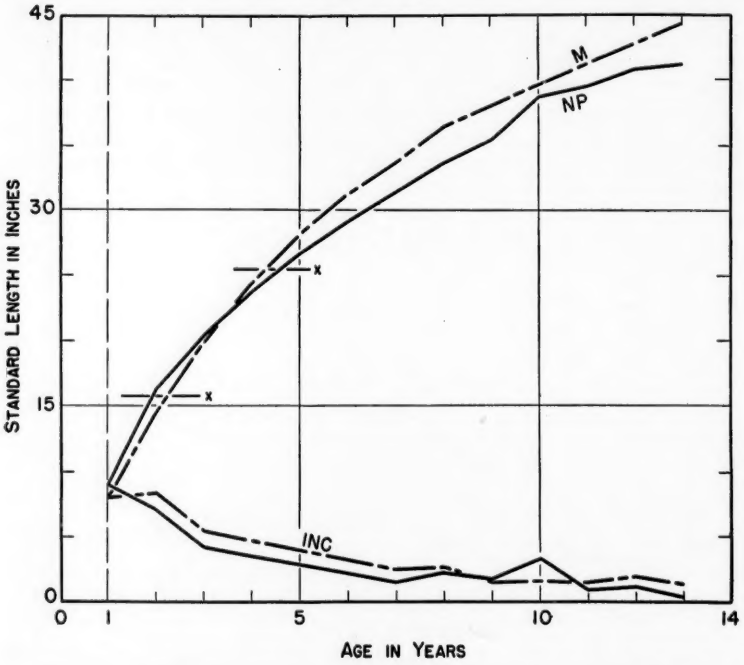

Fig. 3. Comparative growth in length of northern pike and muskellunge in Wisconsin.

The increment curves represent the differences between the average calculated lengths for each year of life. M, Muskellunge; NP, Northern pike; x, the legal length.

The early rapid growth brings the average northern pike to the legal length of 18 inches (15.9 inches standard length) by the end of the second year of life (when it becomes two years old). (Figure 3.) A comparison with the growth curve for the muskellunge (Schloemer, 1936) shows that the northern pike is longer than a muskellunge of the same age until the middle of the fourth year of life, when the muskellunge, because of its greater yearly increment, attains the greater length. It is interesting, moreover, to note that the one northern pike in its fourteenth year of life is only 3 inches shorter than a muskellunge of the same age. The maximum age of the northern pike specimens in the collection was fourteen years, while the muskellunge is reported to reach twenty years. Only 9 out of 351, or 3 per cent, of the muskellunge reported by Schloemer were older than fourteen years.

Table 5 is a comparison of the northern pike and muskellunge as to the time when the lengths of 18 and 30 inches are attained. It shows that 50 per cent of the northern pike attained the legal length of 18 inches at the end of the second year of life, and 30 inches at the end of the fourth year of life, while 50 per cent of the muskellunge attained the legal length of 30 inches early in the fifth year of life. At the end of the third year of life 98 per cent of the northern pike had reached 18 inches in length, while of 134 specimens reaching a length of 30 inches, 73 per cent did so before the middle of the fifth year of life.

TABLE 5

COMPARISON OF NORTHERN PIKE AND MUSKELLUNGE AS TO THE TIME WHEN THE LENGTHS OF 18 AND 30 INCHES ARE ATTAINED

TABLES 5A AND 5B, NORTHERN PIKE; TABLE 5C, MUSKELLUNGE

Lake	County	Length attained
A		18 inches
Waubesa	Dane	Early in second summer
Mendota	Dane	Middle of second summer
Bearskin	Oneida	End of second summer
Green	Green Lake	End of second summer
Rock River	.....	End of second summer
	Average	
Sturgeon Bay	Door	Early in 3rd summer
Delta	Bayfield	Middle of 3rd summer
Windigo	Sawyer	End of 4th summer
Prairie	Barron	Early in 6th summer
B		30 inches
Lawrence Pond	Marquette	Late in 3rd summer
Monona	Dane	Late in 3rd summer
Waubesa	Dane	Middle of 4th summer
Mendota	Dane	Late in 4th summer
Spring	Green Lake	Late in 4th summer
	Average	
Bardon	Douglas	Late in 5th summer
Sturgeon Bay	Door	Middle of 6th summer
Delta	Bayfield	Middle of 7th summer
C		30 inches
Grindstone	Sawyer	Middle of 4th summer
Wisconsin River	.....	Late in 4th summer
Lost Land	Sawyer	Late in 4th summer
Muskellunge	Vilas	Late in 4th summer
Pelican	Sawyer	Late in 4th summer
Allequash	Vilas	Early in 5th summer
Big Arbor Vitae	Vilas	Early in 5th summer
Chipp. Flowage	Sawyer	Early in 5th summer
	Average	
Teal	Sawyer	Late in 5th summer
Sand	Sawyer	Late in 5th summer
High	Vilas	Late in 5th summer
Big	Vilas	Late in 5th summer
Clear	Vilas	Early in 6th summer
Moose	Sawyer	Early in 6th summer
Ghost	Sawyer	Late in 6th summer
Spider	Vilas	Late in 6th summer
Island	Vilas	Late in 7th summer

The relationship between length and weight can be used in another interesting comparison of Wisconsin northern pike and muskellunge. The curves of Figure 4 are heretofore unpublished data from 480 northern

pike and 601 muskellunge, and were sketched through points which represent average weights for 25 millimeter length intervals. It is immediately apparent that the young northern pike exceeds in weight muskellunge of similar size until about 21.6 inches (550 millimeters) is attained, when fish of both species weigh about 2.2 pounds (1,000 grams). At a length of 18 inches a northern pike will weight 1.32 pounds (600 grams), and a muskellunge 1.0 pound (454 grams); at 30 inches a northern pike will weight 6.6 pounds (3,000 grams), and a muskellunge 7.7 pounds (3,500 grams).

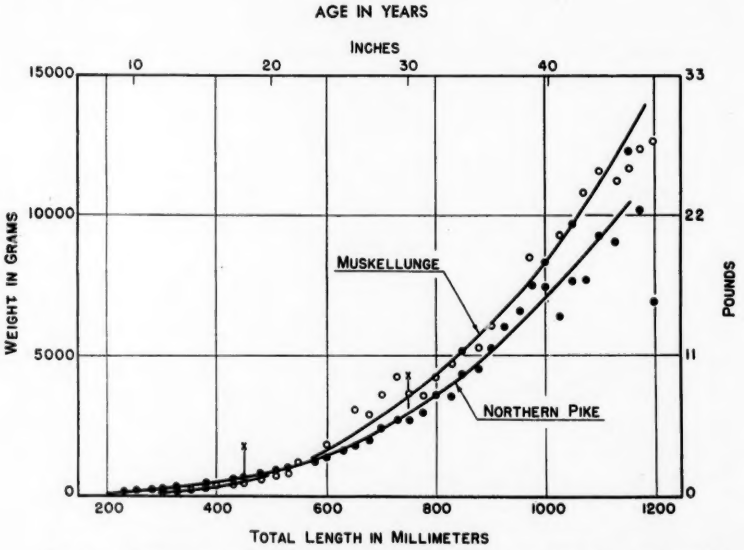

Fig. 4. Comparative length-weight relationship of the northern pike and muskellunge. The legal length is represented by x.

The data of Table 6 give the average coefficient of condition, K, for the various age groups. There is noted a tendency for the value of the coefficient to increase with increasing age, indicating an increase in relative heaviness in the life of the northern pike. The low value of the coefficient is evident from the familiar long and slender form of the species.

Scales and data of 73 northern pike of Illinois from the collection of the Illinois Natural History Survey were used for a comparison with the growth rate in Wisconsin. The collection included specimens taken from 1930 to 1937 from 6 rivers and 4 lakes of Illinois. Of all the 5 age groups represented, age groups I, II, and III made up 94.5 per cent of the returns. The largest specimen was 37.3 inches in total length, weighed 9.5 pounds, was caught in Fox Lake, May 28, 1930, and was in its seventh year of life. The average calculated lengths (Illinois, Table 7; Wisconsin, Table 1) compare favorably for the first two years. However, if there is an increase in the calculated growth of the different age groups in the northern pike,

as observed in the Wisconsin data, then the absence of older age groups in the Illinois collection affects the averages there obtained, and would tend to make them too low. The Illinois averages compare most favorably with the growth rate of Lake Delta, in northern Wisconsin.

TABLE 6
AVERAGE COEFFICIENTS OF CONDITION, K, OF VARIOUS AGE GROUPS OF NORTHERN PIKE

Age group	Average actual length, inches	Frequency	Average K	Frequency
XIII	46.9	1	.592	1
XII	....	0	....	0
XI	44.8	2	.381	2
X	44.3	3	.738	3
IX	39.6	13	.694	13
VIII	37.3	12	.666	11
VII	35.0	25	.656	23
VI	31.6	41	.655	36
V	29.2	48	.616	44
IV	27.0	87	.626	84
III	23.4	109	.635	97
II	21.5	123	.641	110
I	19.9	51	.628	44
0	11.1	13	.629	12

TABLE 7
AVERAGE CALCULATED TOTAL LENGTHS OF VARIOUS AGE GROUPS OF NORTHERN PIKE FROM ILLINOIS

Age group	Fre-quency	Average calculated total length in inches					
		1	2	3	4	5	6
VI	1	12.1	24.4	28.6	32.7	35.5	36.9
V	0	.....	.....	.....	.....	.....	.....
IV	3	9.7	16.5	20.5	23.6	.....	.....
III	17	9.2	17.0	21.0	.....	.....	.....
II	32	10.4	17.9	.....	.....	.....	.....
I	20	9.5	.....	.....	.....	.....	.....
Frequency*	72	72	52	20	3	.....	.....
Average length*	.....	9.9	17.5	21.0	23.6	.....	.....

* Excluding age group VI.

The glacial lakes of the Fox River drainage system of Illinois, which are represented by 84.9 per cent of the Illinois northern pike data, have been compared before with glacial lakes of Wisconsin. Schloemer, 1939, showed that the growth rates of bluegill populations in these Illinois lakes and of Lake Chetac in northern Wisconsin agreed closely, suggesting that influences other than length of growing season affect the rate of growth.

In an analysis of 324 pickerel caught during the spawning run in Lake Waskesiu, Prince Albert National Park, Saskatchewan, Rawson, 1932, determined the minimum spawning age. Some, but not all, of the

females appeared to spawn at the end of the third year. Few if any males matured until the end of the fourth year. Forty-six per cent of the spawning population were of the age groups IV, V, and VI. On the scales of females, Rawson also found a definite check at the beginning of the fourth year's growth, which he attributed to the first spawning period. This check was not found in the scales of the males in Rawson's collection, and nothing definite was noted on the scales of either males or females in the Wisconsin or Illinois collections.

Discussion

The relative importance of the northern pike as a food and game fish is a subject on which fishermen disagree. It is true that an enormous poundage of food, mostly of other fishes, is required to bring a pickerel up to catchable size, and for that reason it may be considered detrimental to other valuable species. On the other hand, the pickerel is an attraction to anglers because it is one of our largest fresh-water fishes and a persistent though not quite as spectacular fighter as the muskellunge. The northern pike, caught in northern portions of Europe and Asia, and in North America southward to Missouri, the northern part of the Ohio valley and eastern New York, is more widely distributed than the muskellunge, which is limited to the Great Lakes, the St. Lawrence and upper Ohio drainage basins, and to Minnesota, Wisconsin, Iowa, Illinois, and Canada. Also, as shown in this growth study, there is a parallel relationship between the two species in length and weight. With the proper correction of the present conservation laws and education of the fishing public it may be possible to "build" the northern pike into as great an attraction to anglers as the muskellunge.

The data collected in this growth study show that 50 per cent of the northern pike reach the legal length of 18 inches by the end of the second year of life, and that 98 per cent attained this length by the end of the third year of life. Also, it has been observed that 62 per cent of the specimens in the Wisconsin collection were of the second, third, and fourth age groups. As previously stated, Rawson determined that the minimum spawning age was three years in the females and four years in the males in Lake Waskesiu. Although the minimum spawning age for Wisconsin pickerel is not exactly known, it should be about one year less than Rawson's determinations, considering the differences in mean annual temperature. As a result, 98 per cent of the pickerel in Wisconsin would be subject to capture before they spawned more than once. A common guiding principle in providing what might be called "normal" protection for a fish population is to set the legal limit so that every fish will be allowed to mature and to spawn at least once or twice. Therefore, it is the opinion of the writer that the present legal limit of 18 inches is not sufficient to maintain a self-perpetuating population. A minimum limit of 23 inches (3.3 pounds corresponding weight) would protect the average northern pike for three years and probably allow it to spawn at least once. A minimum of 27 inches (5 pounds corresponding weight) would protect the average northern pike for four years and allow it to spawn at least once or twice. A legal limit of 30 inches (6.6 pounds corresponding weight)

would protect the average northern pike for five years and provide for anglers a fish as potential an attraction as the muskellunge.

Summary

1. This growth study is an analysis of the size data and scales from 515 northern pike from 98 lakes and 9 rivers of Wisconsin, obtained from anglers of the state.

2. Age groups II, III, and IV make up 62 per cent of the specimens.

3. The ratio of standard to total length is 1 : 1.13.

4. Growth curves of the northern pike in Wisconsin—Lake Mendota (Dane County), Sturgeon Bay, and Lake Delta (Bayfield County)—and in northern Saskatchewan, Lake Waskesiu, indicate a positive correlation between rate of growth and range of latitude.

5. Early, rapid growth brings the average northern pike to the legal length of 18 inches (15.9 inches standard length) by the end of the second year of life.

6. Comparison with the muskellunge shows that the northern pike has a similar rate of growth in length; the length of 30 inches is attained by the end of the fourth year of life by the northern pike, and early in the fifth year of life by the muskellunge.

7. Growth in weight is also very similar in the two species; at 18 inches a northern pike will weight 1.32 pounds, a muskellunge 1.0 pound; at 30 inches a northern pike will weight 6.6 pounds, a muskellunge 7.7 pounds.

8. The coefficient of condition is 0.6+, increasing in value with an increase in age.

9. Average growth rates of Wisconsin and Illinois northern pike are shown to be similar for the first two years. The Illinois specimens, of which 84.9 per cent are from the Fox River drainage system, compare more favorably with the specimens from northern Wisconsin Lake Delta, suggesting influences other than lengths of growing seasons.

Literature Cited

Bennett, G. W.

1937 The growth of the large-mouthed black bass, *Huro salmoides* (Lacépède), in the waters of Wisconsin. Copeia, 1937: 104–118, figs., 1–6.

1938 Growth of the small-mouthed black bass, *Micropterus dolomieu* Lacépède, in Wisconsin waters. Copeia, 1938: 157–170, figs., 1–4.

Hile, R.

1936 Age and growth of the cisco, *Leucichthys artedi* (Le Sueur), in the lakes of the northeastern Highlands, Wisconsin. *U. S. Bureau of Fish. Bull.* 48: 211–317.

Rawson, D. S.

1932 The pike of Waskesiu Lake, Saskatchewan. *Trans., American Fish. Soc.*, 1932, 62:323–330.

Schloemer, C. L.

1936 The growth of the muskellunge, *Esox masquinongy immaculatus* (Garrard) in various lakes and drainage areas of northern Wisconsin. Copeia, 1936, 4: 185–192, figs., 1–5.

1938 A second report on the growth of the muskellunge, *Esox masquinongy immaculatus* (Garrard), in Wisconsin waters. *Trans., Wisconsin Acad. Sciences, Arts and Letters*, 1938, 31: 507–512.

1939 The age and rate of growth of the bluegill, *Helioperca macrochira* (Rafinesque). *Ph.D. thesis manuscript, University of Wisconsin.*

UNIVERSITY OF WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY, MADISON, WISCONSIN.

The Sex Ratio and Seasonal Distribution of Some Florida Sharks

By STEWART SPRINGER

MEEK (1916) states that sharks and dogfish lead a roving existence, and that it is not known definitely whether females resort to a particular region for the liberation of the young. He qualifies this in specific instances, and says of *Acanthias vulgaris* on the coast of Sweden, "The migrations are local during the phase of immaturity, and when the dogfish reach maturity, they tend to migrate into shallow water in summer and to deep water for winter, keeping together in large companies." For larger species he says, "It is plain, however, that they migrate, and it is known in many cases that they migrate toward continental waters periodically." It is important for taxonomic studies of sharks to record information of their seasonal migratory movements, particularly whether they are simple inshore-offshore migrations, or whether they are regular long distance movements up and down the coasts. Great numbers of the common spiny dogfish, *Squalus acanthias,* are present during the winter in water of moderate depths (30 to 70 fathoms) off the coast of Virginia and the Carolinas. The species is abundant on the New Jersey coast where it is caught in pound nets in spring and fall, appearing on the New England coast in the late spring, summer, and early fall. Bigelow and Schroeder (1936: 323) report late embryos from females taken off New York in autumn and from females taken on the Virginia and North Carolina wintering grounds. My collections of embryos taken from females caught off Norfolk in early February, include a few specimens with large yolk-sacs although in most the yolk-sacs were nearly or completely absorbed. Hildebrand and Schroeder (1928: 53) suggest that the young *Squalus* may be born in either the spring or autumn, but that as the gestation period is probably ten or eleven months, a single female could only produce offspring once a year. Presumably there are regular north and south movements of at least a part of the North Atlantic-American population of *Squalus acanthias,* but there is evidently an inshore-offshore movement also (see Bigelow and Welsh, 1925: 47) and the relation of the migration to the

birth of the young is not definitely determined. My experience with the Norfolk dogfish was limited to one catch of about five thousand pounds, consisting of approximately equal numbers of both sexes. About half of them were mature and all of the large females that were examined carried embryos. Movements of other American species of sharks are not so well known and in some of the larger ones interesting complications are suggested by the available data. I have previously reported on the segregations of the males of *Scoliodon terra-novae* during the young producing period (Springer, 1939: 19)). Such segregation of the sexes in schools may frequently occur.

A complete record was kept for the adult specimens of the nine common large sharks of the families Carcharinidae and Sphyrnidae taken at Englewood, Florida, during the first six months of 1939. This supplements less complete records kept of the Englewood catch for the preceding four years. Most of the large sharks were taken on chain set lines about 10 miles offshore in about 45 feet of water. No quantitative record was made for immature individuals which were mostly brought in by anglers or by commercial fishermen using gill nets and trammel nets. The scientific names used here are those applied to Florida specimens in a previous paper (Springer, 1939), in which diagnostic features of the species were outlined.

Variation Within Species in the Englewood Shark Population

When compared in size groups, species of sharks taken at Englewood have shown comparatively little variation in form. The teeth of certain species of sharks such as the *Scoliodon terra-novae* may be subject to change in shape during growth. But in *Carcharinus platyodon, Hypoprion brevirostris, Isogomphodon limbatus, Sphyrna tudes,* and *Galeocerdo arcticus* the teeth of various sizes of either sex are essentially similar. As only adults of *Carcharinus milberti,* only adult females of *C. obscurus,* and only adult males of *Isogomphodon maculipinnis* have been taken at Englewood, comparisons of size groups of these have not been made. The Englewood specimens of *Sphyrna zygaena* that I have examined have all had relatively erect teeth in the lower jaw and all teeth are without serrations, but this is not generally true of the common hammerheads of the Atlantic coast of the United States, and it is possible that two species of the common hammerhead are present in the area in addition to the great hammerhead, *Sphyrna tudes,* and the shovel-nose shark, *Sphyrna tiburo.* The Englewood population, however, is represented by specimens without marked variation in tooth form.

The number of vertical rows of teeth were counted in dry jaws taken from Englewood specimens during the later part of 1938 and early 1939. Table 1 shows the variation in the material examined. At the symphysis of the cartilages forming each jaw there are usually one or more irregular rows of minute teeth in *Carcharinus* and related genera. The central figures of the formulas which I give here refer to the approximate number of rows of these teeth, while the other figures refer to the number of rows on either side.

Winter Shark Population at Englewood

In November *Carcharinus milberti* and *C. obscurus* appear in the Englewood catch, and these two species remain the most abundant of the large

sharks until March. No immature specimens of either species have been collected, and, as collecting has been done with a variety of methods and some regularity, I am of the opinion that this means that young are not normally liberated in the Englewood area and that immature individuals do not include the area within their range. In 1939 as in previous years, no males of *Carcharinus obscurus* were taken, and only a few males of *C. milberti* appeared. It may be significant that only about 17 per cent of the female *milberti*, and only about 13½ per cent of the female *obscurus* carried embryos. Also, it is noteworthy that the size of the embryo is apparently not correlated with the advance of the season in so far as the Englewood material goes.

TABLE 1

COUNTS OF NUMBER OF VERTICAL ROWS OF TEETH FROM DRY JAWS OF MATURE SHARKS TAKEN AT ENGLEWOOD, FLORIDA, IN 1938-39

Species	Number of specimens	Minimum	Typical	Maximum
Carcharinus milberti	23	14 1 14	14 2 14	15 2 15
		13 1 13	14 1 14	14 2 14
Carcharinus obscurus	32	14 1 14	15 2 15	15 3 15
		13 2 13	14 2 14	15 3 15
Carcharinus platyodon	13	12 1 12	13 1 13	13 1 14
		12 1 12	12 1 12	13 1 13
Isogomphodon maculipinnis	9	16 1 16	17 2 17	17 3 17
		15 1 15	16 1 16	16 1 16
Isogomphodon limbatus	22	15 2 15	15 3 15	15 4 16
		14 2 14	14 2 14	15 1 15
Hypoprion brevirostris	8	14 2 13	15 2 15	15 2 15
		12 2 13	13 2 13	14 3 14
Galeocerdo arcticus	22	10 1 10	11 1 11	11 1 12
		10 1 10	11 1 11	12 1 12
Sphyrna zygaena	6	15 1 15	16 0 16	16 2 16
		15 1 14	15 1 15	15 1 15
Sphyrna tudes	5	16 3 16	17 2 17	18 2 17
		15 2 16	16 2 16	18 3 17

In contrast to these species with mature females predominating, *Isogomphodon maculipinnis* is represented in the winter catch only by adult males and no females or immature specimens have been taken at any time. The closely allied *I. limbatus* is also present in winter, but the winter population is made up mostly of females. An examination of the winter catch alone would suggest the existence of one dimorphic species of *Isogomphodon*. One adult male *limbatus* was recorded for March, 1939, and summer collections of both sexes in all size groups have been made. The species, although taken in all months of the year, is commoner in spring and fall.

Young and immature specimens of *Sphyrna zygaena* are more common in spring and fall but are regularly present except in mid-summer. Large individuals are common in winter and are mostly adult and sub-adult males.

Galeocerdo arcticus and *Hypoprion brevirostris* are both represented in the Englewood catch throughout the year. Both liberate young in the vicinity of Englewood, and *Galeocerdo* mates in Englewood waters. In the late spring some *Galeocerdo* females with nearly full term embryos have been taken, but at the same season specimens have been captured which contained newly fertile eggs. *Galeocerdo* is more abundant in spring and fall while *Hypoprion* appears to be most abundant in late summer. Neither of these species shows any great preponderance of one sex in the Englewood catch.

TABLE 2

NUMBER OF MATURE SHARKS IN CATCH OF ENGLEWOOD SHARK STATION IN 1939

Species	Sex	January	February	March	April	May	June	Total
Carcharinus	Males	1	3	0	0	0	0	4
milberti	Females	49	18	9	0	0	0	76
Carcharinus	Males	0	0	0	0	0	0	0
obscurus	Females	36	7	1	0	0	0	44
Carcharinus	Males	1	0	0	0	1	2	4
platyodon	Females	0	0	2	0	7	8	17
Isogomphodon	Males	0	0	1	0	0	0	1
limbatus	Females	10	2	0	0	0	0	12
Isogomphodon	Males	5	2	4	0	0	0	11
maculipinnis	Females	0	0	0	0	0	0	0
Hypoprion	Males	0	0	0	0	9	0	9
brevirostris	Females	2	0	5	0	6	2	15
Galeocerdo	Males	4	0	5	1	4	1	15
arcticus	Females	1	2	5	0	2	1	11
Sphyrna	Males	1	0	1	1	0	0	3
zygaena	Females	0	0	0	0	0	0	0
Sphyrna	Males	0	0	0	0	0	0	0
tudes	Females	0	0	1	1	3	1	6

SUMMER SHARK POPULATION AT ENGLEWOOD

Carcharinus platyodon is primarily a summer species, and, until 1939 when a few specimens were taken in January and March, it had not been collected in winter. Immature individuals are taken frequently, and the species, like *Galeocerdo*, is present in summer but more abundant in spring and fall.

In the late spring and early summer few large sharks are present, but *Galeocerdo, Hypoprion, Isogomphodon limbatus, Carcharinus platyodon*, and *Sphyrna tudes* are captured in small numbers. At this season tarpon fishermen are troubled by sharks catching the spent tarpon and generally report an abundance of sharks. However, a shark set line of twenty to fifty hooks will catch out the area in which it is set in a day or so, producing relatively few sharks, and then has to be moved to get results. Shark fishermen are of the opinion that large sharks are well scattered and not traveling at this season on the west coast of Florida.

GEOGRAPHICAL RANGE OF SOME SPECIES OF THE ENGLEWOOD SHARK POPULATION

Carcharinus milberti and *C. obscurus* are widely used names but it is questionable whether they have always been used for the same species. Probably both species are confined to the Atlantic coast of North America

and have a nearly parallel distribution. Both are adequately described by Nichols and Murphy (1916: 13-16), and *C. milberti* by Radcliffe (1914: 257-259). Smith (1907: 34) records a specimen with small embryos from Beaufort as *milberti,* but this is probably the form which I refer to *obscurus*. The diagnosis given by Smith relating to pectoral fin length is adequate for embryos and young, and the young *milberti* that I have examined have had short, broad pectorals, their length 6 to 6½ times in the total length. However, in adults of 200 to 220 cm, the pectoral fin length will go only about 5 times in the total length, and the fins may be described as falcate. *C. obscurus* is not only less abundant than *milberti* but its adult size of over 9 feet has made recorded captures infrequent.

TABLE 3

EMBRYOS OF ENGLEWOOD SHARKS, JANUARY TO JUNE, 1939. THE TOTAL NUMBER OF SEXUALLY MATURE FEMALE SHARKS EXAMINED DURING THIS PERIOD IS SHOWN IN TABLE 2

Species		January	Febr'y	March	April	May	June
Carcharinus milberti	Number of litters	9	2	2	0	0	0
	Number of males	41	11	7			
	Number of females	44	8	11			
	Average length in mm	429	433	459			
Carcharinus obscurus	Number of litters	5	0	1	0	0	0
	Number of males	13		4			
	Number of females	11		0			
	Average length in mm	805		600			
Carcharinus platyodon	Number of litters	0	0	0	0	1	0
	Number of males					5	
	Number of females					1	
	Average length in mm					710	
I. limbatus	Number of litters	2	0	0	0	0	0
	Number of males	6					
	Number of females	6					
	Average length in mm	360					
H. brevirostris	Number of litters	0	0	0	0	4	0
	Number of males					30	
	Number of females					25	
	Average length in mm					502	
Galeocerdo arcticus	Number of litters	0	0	1	0	1(2)*	0
	Number of males			18		21	
	Number of females			18		16	
	Average length in mm			620		500	
Sphyrna tudes	Number of litters	0	0	1	0	3	1
	Number of males			16		28	17
	Number of females			9		34	14
	Average length in mm			450		620	625

* One female carried eggs (about 34) in very early stage of development.

Carcharinus obscurus was not recorded by Radcliffe from the Beaufort region. Firth (1931: 9) writes of an 11 foot *obscurus* taken from the northeast peak of Georges Bank on August 10, and Garman (1913: 130–131) bases his descriptive account of the species on material from Buzzards Bay, Massachusetts, evidently including one specimen of 40 inches. As 38 inch embryos have been collected at Englewood, it is likely that Garman had described new-born young. I have seen adult females from Salerno, Florida, and judging from the catch records, which give common names and hide lengths,

I suppose that the species may be present on the east coast of Florida throughout the year although commoner in the cold months.

Nichols and Murphy record *Carcharinus milberti* as numerous in the vicinity of Long Island and state that females enter Great South Bay in midsummer to give birth to their young, and further that the species is in evidence about Block Island from May until November. I have seen a number of new-born young with fresh pseudoplacental attachment scars which had been collected near Woods Hole, Massachusetts. Hildebrand and Schroeder (1928: 48) give Chesapeake Bay records of very small individuals. Mr. E. Milby Burton and Mr. T. K. Ellis have sent me measurements and descriptions of half-grown as well as mature individuals from Charleston, South Carolina. I have seen several dozen adults from the east coast of Florida and the catch records suggest that *milberti* is the most abundant of the commercially valuable species. While I have not been able to find any evidence that immature *milberti* occur on the east coast of Florida, my opportunities for collecting there have been quite limited.

Isogomphodon limbatus is common in the extreme north Gulf in summer and produces young there. This species is mentioned for Great South Bay by Nichols and Murphy and is recorded by Radcliffe for the Beaufort region. Nichols (1917: 874–875) reports on the capture of five *limbatus* on the southwest coast of Florida, the four largest with embryos, three to six each. Mr. Nichols' remarks are of special interest because of his extensive field experience with the sharks of the east coast of the United States. He says, "It is significant that no males of this species (*limbatus*) or of *C. acronotus*, which also had young, were met with. It appears that when with young, female ground sharks (*Carcharinus*) are not accompanied by males of the same species. Considerable data proves this for *C. milberti* of Great South Bay, N.Y."

Although he did not recognize the species, Coles (1919: pl.3, fig.2) gives a photograph of *Sphyrna tudes* from Cape Lookout, North Carolina, collected early in July. Radcliffe (1916: pl.43, figs. 4 and 5) also shows a photograph of dry jaws obtained from Dr. E. W. Gudger and from a specimen taken in Beaufort Harbor on July 20 which appears to be referable to *Sphyrna tudes*. Recognition of the form has been complicated by the presence of two other species of large hammerhead on the Atlantic coast of the United States and by the misleading diagnosis for *tudes* given by Jordan and Evermann (1896: 44).

Sphyrna tudes, Hypoprion brevirostris, Carcharinus platyodon, Galeocerdo arcticus, and *Isogomphodon limbatus* all give birth to young in the vicinity of Englewood, all are less common in winter, and it seems probable that with these species there is a general tendency for southern migration in winter. *Galeocerdo, C. playodon,* and *Isogomphodon limbatus* disappear from the waters of the extreme north Gulf in winter, and their increased abundance at Englewood in spring and fall suggests a migratory passage.

The Sex Ratio in the Englewood Shark Population

The sharks under consideration here appear to produce about equal numbers of male and female pups. No great difference has been noted in the numbers and sexes in those species which are represented in the Englewood

fauna by half-grown individuals. *Galeocerdo arcticus* and *Hypoprion brevirostris,* however, are the only large sharks taken at Englewood in which adults are represented by nearly equal numbers of the sexes. *Galeocerdo* is the only shark known definitely to mate in the vicinity of Englewood.

For *Carcharinus milberti* and *C. obscurus* there is some confirming evidence that adult females actually far outnumber males in the relatively small number of mature females that are gravid during the mid-winter. There are plausible but highly speculative explanations for this phenomenon which may be deduced from the probable effects of copulation on the specialized claspers of the males. At present there seems to be no evidence that the males have a separate geographical range nor does there appear to be any evidence that females bear young more than once a year or give birth to young at any other time than the spring and early summer. While statistical records are not available, my observations of smaller species such as *Carcharinus acronotus, Isogomphodon limbatus,* and *Scoliodon terra-novae* lead me to believe that most adult females of these species are gravid at the proper season. Most of the adult females of *Sphyrna tudes* taken at Englewood in the spring carry embryos. Elasmobranchs as a class show considerable structural specialization in the reproductive system, and it is not unlikely that various habit patterns have developed for different species as a result. Undoubtedly each species should be considered as presenting a special case.

Literature Cited

Bigelow, H. B. and W. C. Schroeder
1936 Supplemental notes on the fishes of the Gulf of Maine. *Bull. U. S. Bur. Fish.,* 48 (20): 319–343.

Bigelow, H. B. and W. W. Welch
1925 Fishes of the Gulf of Maine. *Ibid.,* 40 (pt. 1); 1–567.

Coles, R. J.
1919 The large sharks of Cape Lookout, North Carolina. Copeia (69): 34–43.

Firth, Frank E.
1931 Some marine fishes collected recently in New England waters. *Bull. Bost. Soc. Nat. Hist.,* 61: 8–14.

Garman, Samuel
1913 The Plagiostomia. *Mem. Mus. Comp. Zool.,* 36: 1–515, pl. 1–77.

Hildebrand, S. F. and W. C. Schroeder
1928 Fishes of Chesapeake Bay. *Bull. U. S. Bur. Fish.,* 43 (pt. 1): 1–366.

Jordan, D. S. and B. W. Evermann
1896 The fishes of North and Middle America. Part 1. *Bull. U. S. Nat. Mus.,* 47(pt. 1): 1–1240.

Meek, Alexander
1916 The migrations of fish. *Edward Arnold, London.* Elasmobranchs: 38–41.

Nichols, J. T. and R. C. Murphy
1916 Long Island fauna. The sharks. *Brooklyn Mus. Sci. Bull.* 3 (1): 1–34.

Nichols, J. T.
1917 Ichthyological notes from a cruise off southwest Florida with a description of *Gobiesox yuma. Bull. Am. Mus. Nat. Hist.,* 37 (37): 873–877.

Radcliffe, Lewis
1916 The sharks and rays of Beaufort, North Carolina. *Bull. U. S. Bur. Fish.* 34: 241–284, pl. 38–49.

Smith, Hugh M.
1907 The fishes of North Carolina. *No. Car. Geol. and Econ. Surv.,* 2; 1–449, pl. 1–21.

Springer, Stewart
1939 Notes on the sharks of Florida. *Proc. Fla. Acad. Sci.,* 3 (1938): 9–41.

Bass Biological Laboratory, Englewood, Florida.

A New Record of Two Flounders, *Etropus crossotus* Goode and Bean and *Ancylopsetta dilecta* (Goode and Bean), With Notes on Postlarval Characters[1]

By Sidney C. T. Hsiao[2]

THE research ketch "Atlantis" of the Woods Hole Oceanographic Institution caught fifteen postlarval *Etropus crossotus* and two postlarval *Ancylopsetta dilecta* by oblique hauls made by a 2 meter open stramin net along the outer slope of Georges Bank, September 7-12, 1939. These postlarval Paralichthinae were found at four stations two of which are on the southern slope of the eastern tip of Georges Bank (about 41° N., 66° W.) and the other two also on the southern slope but about 180 nautical miles to the southwest. At the shallower stations the stramin net was drawn from a point near the bottom up to the surface, while at the deeper stations it was drawn through the top 160 meter layer only. The specimens were taken in hauls made during morning, afternoon and midnight.

The collections represent a more northerly and easterly record than has been reported heretofore for these two species. On this side of the American coast *E. crossotus* occurs between Chesapeake Bay and the West Indies and *A. dilecta* is found off the coast of Carolina. No adult of either species has been observed over Georges Bank or in the Gulf of Maine. The postlarval individuals caught off Georges Bank were most probably spawned further south and transported to this place by the Gulf Stream. It has been established that tropical forms actually come over the slope on to Georges Bank and further into the Gulf of Maine (compare Bigelow, 1924: 51–59). Our collections may be another case of "tropical visitors." If these flounders were spawned on the continental slope or over the shelf off the coast of Florida it would be a comparatively simple matter for the Gulf Stream to carry them northward to the Georges Bank region.

The specimens of *E. crossotus* ranged in total length[3] from 6.5 to 15 mm. From their small size it may be inferred that they had not drifted very long but were spawned sometime in late summer or early fall. The specimens of *A. dilecta* were probably spawned at about this same time, for their total length is only 8.0 to 8.2 mm.

As no newly metamorphosed or adult *Etropus* or *Ancylopsetta* has been reported inside the Gulf of Maine it is doubtful if the young of these species can survive the conditions within the Gulf.

A figure of the larval form of *E. rimosus* and one of a young specimen of *Notosema* (=*Ancylopsetta*) *dilecta* are given in *Oceanic Ichthyology* by Goode and Bean (1896). Except for these figures no drawing or description of the postlarval stages of American Paralichthinae belonging to these two

[1] Contribution No. 254 of the Woods Hole Oceanographic Institution.

[2] This work has been supported by a research fellowship from the China Foundation and carried out under the direction of Prof. H. B. Bigelow.

[3] The measurements and terms defined by Norman (1934: 50–51) as well as his classifications are followed in this paper.

genera has been published. The following descriptions based upon material preserved in formalin are made to fill this gap.

Etropus crossotus.—Postlarvae, less than 10 mm. in total length, corresponding to Kyle's (1913) early postlarval stage; whitish, almost transparent, with internal organs clearly visible, and so greatly compressed laterally as to become laminate. Dorsal body outline gently convex; upper profile of head slightly concave. Maxillary extending to anterior edge of eye. Larval teeth on both sides of both jaws. Vent nearer to the snout than to the base of caudal. Dorsal originating in front of eye, directly dorsal to the external nare on dextral side. "Dorsal tentacle" present (bifurcated in

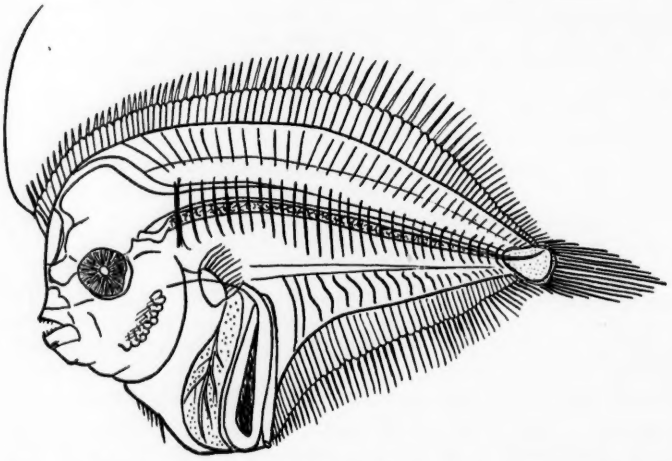

Fig. 1. *Etropus crossotus,* total length 6.5 mm. Camera drawing from specimen stained with borax carmine.

our much handled material), much elongated, with maximum length about ⅓ the length of the fish. Dorsal 78-87; rays at beginning of the posterior half of body longer than the rest. Anal 59–65, originating from posterior margin of vent; rays at the posterior half of body longest. Ventral 6, midway between snout and vent. Air-bladder simple, transparent, between viscera and 7th to 10th vertebrae. Vertebrae 9 + 25. No pigmentation.

Individuals longer than 10 mm. in total length, corresponding to Kyle's late postlarval stage, translucent, "temporary characters" disappearing: air-bladder very small or absent, "dorsal tentacle" absent, but its base remaining.[4]

The classification of *Etropus* is in an unsatisfactory state (contrast the opinion of Jordan and Evermann, 1898; Bean, 1901; Parr, 1931; and Norman, 1934). By adopting Norman's classification and by comparing the

[4] The relative size of the different parts of the body, a less constant character, has not been included in this description.

radial formulae of our material with those found in literature on this group, we identify our specimens with *E. crossotus*.

Ancylopsetta dilecta.—Both specimens (8 mm. and 8.2 mm. in total length) symmetrical. Body slightly elongated. Dorsal curve gently convex, but abruptly concave in the interorbital region; ventral curve nearly straight except for a sharp upward bend immediately behind the vent. Vent midway between snout and base of caudal. Body region behind vent greatly compressed laterally; head and anterior region of trunk thicker. Greater part of body translucent. Maxillary extending to below middle of eye. Head bony in appearance. One spine standing out clearly in frontal view as a lateral

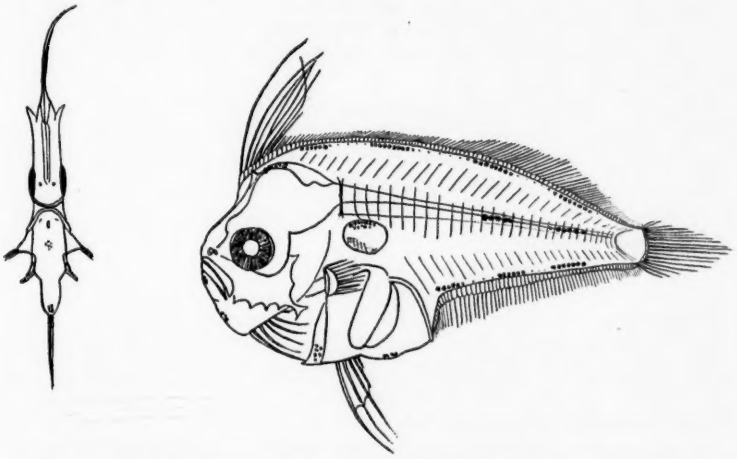

Fig. 2. *Ancylopsetta*, total length 8 mm. Camera drawing from specimen preserved in formalin, unstained.

projection on the sphenotic region immediately ventral to the anterior end of the dorsal, and at some distance above the eye. Four subequal bony triangular projections on ventral edge of preoperculum whose postero-ventral angle is adorned with a large, elongated, quadrangular process. Air-bladder large, transparent, pigmented on its dorsal side, between the abdominal vertebrae and viscera. Dorsal fin originating over anterior margin of eye on dextral side. continuing to the caudal near which the rays are not well differentiated; anterior 8 rays much elongated, nearly equal to each other. Of the other rays those at the beginning of the posterior half of trunk longest; dorsal more than 66. Anal more than 55; originating immediately behind vent; middle group of rays longest. Pectoral anterior to ventral. Ventral on sinistral (future ocular) side with 3 much elongated rays followed by 2 or 3 shorter ones; longest ventral slightly shorter than longest dorsal fin rays. The other ventral not elongated. Caudal 18, strongly double-truncate. Vertebrae 35. Pigmentation consisting of a system of 3 lines and 5 blotches. The

linear series run along (1) dorsal body edge, (2) posterior half of lateral line and (3) ventral body border. Dorsal line of pigment cells concentrated into groups at five points where the cells are larger and closer together than in the intervening space. Two similar groups along the lateral line and 3 along ventral body border. Five pigmented blotches occur (1) above the air-bladder, (2) on ventral side of basihyal, (3) on head below the first two bony processes of preoperculum, (4) between tips of branchiostegals and base of ventral and (5) between base of ventral and vent. Figure 2 shows the relative position of the pigment cells.

The drawing given by Goode and Bean (1896: fig. 362) shows a larger individual than our specimen. Unfortunately no size is given by these authors. In their specimen blotches of pigments are present over the interneural and interhaemal spines in association with each group of the dorsal and ventral chain respectively. The bony processes on the head are absent. The caudal has become pedunculate. All these indicate further development than in our material.

There are two species of Atlantic *Ancylopsetta: A. dilecta* and *A. quadrocellata.* In *A. quadrocellata* the ventral fin on the ocular side is not much more elongated than its fellow on the blind side and the anterior rays of the dorsal not so much elongated as in the other species. The elongation of the 8 anterior dorsal rays and of the sinistral ventral fin of our two specimens indicate that they belong to *A. dilecta.*

Summary

This paper makes a new record of the most northerly and easterly occurence of *Etropus crossotus* Goode and Bean and *Ancylopsetta dilecta* (Goode and Bean) based on collections of their postlarvae off Georges Bank. It also records that the probable breeding season of these two species of sinistral Paralichthinae is between late summer and early autumn. The diagnostic characters of the postlarval stages of these forms are described.

Literature Cited

Bean, T. H.
1901 *Ann. Rep. Forest Fish Game Comm. N.Y.*, 6 (1900): 474.
Bigelow, H. B.
1924 *Bull. U. S. Bur. Fish.*, 40 (2): 51–59.
Goode, G. B. and T. H. Bean
1896 *Mem. Mus. Comp. Zool.*, Harvard University 22: 437–439, 450.
Jordan, D. S. and B. W. Evermann
1898 *U. S. Nat. Mus. Bull.*, 47 (3): 2634–2636, 2689.
Kyle, H. M.
1913 *Rep. Danish Ocean. Exped.* 1908–10, 15 (A): 1.
Norman, J. R.
1934 Monograph of the Flatfishes. British Museum (Natural History), London.
Parr, A. E.
1931 *Bull. Bingham Ocean. Collect.* 4 (1): 1–24.

Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.

Ichthyological Notes

THE NOMENCLATURAL STATUS OF THE ASIATIC FISH GENUS *CULTER*.—In a recent paper (Journ. Washington Acad. Sci., 28, 9, 1938: 407–411) Dr. Hugh M. Smith has discussed the genus of Cyprinid fishes long known as *Culter*. His conclusions in regard to the genotype would, if correct, result in the suppression of *Culter* as a synonym of the European genus *Pelecus*, but they do not seem to me to be in accordance with the *International Rules of Zoological Nomenclature*. I have therefore attempted to analyze Dr. Smith's argument and to settle the status of *Culter* in the light of what I believe to be the correct interpretation of the *Rules*.

The essential nomenclatural facts regarding *Culter* itself are simple. Basilewsky (Nouv. Mem. Soc. Imp. Natural. Moscou, 10, 1855: 236) described the new genus *Culter*, under which he includes the descriptions of six new species, *alburnus, erythropterus, mongolicus, pekinensis, exiquus* and *leucisculus*. He makes no statement that one of the included species is the generic type, but in a iine by itself, directly below the generic heading and before mentioning any of his new species, he cites: "(*Cypr. cultratus* Linn.)." Up until the appearance of Dr. Smith's paper, no one has considered that this citation of a Linnaean species constituted a definite genotype designation, although Jordan (Genera of Fishes, 2, 1919: 262) comments that "Basilewsky plainly intended to make his type *Cyprinus cultratus*." Authors (even including Jordan) who have considered the matter of the genotype of *Culter* have, with the sole exception of Dr. Smith, accepted the subsequent and unequivocal designation of *alburnus* as genotype, made by Bleeker in 1863 (Atlas Ichthyol. Indes Orient. Néêrland., 3: 33).

Now, however, Dr. Smith comes forward with the thesis that Basilewsky himself designated the type species of *Culter* when originally describing the genus. Dr. Smith says:

"In setting up *Culter alburnus* as the type of *Culter*, Bleeker and various writers who agreed with him in this course entirely ignored the fact that Basilewsky himself adopted or considered *Cyprinus cultratus* Linnaeus as the type of *Culter*. No other interpretation can be placed on the circumstance that, immediately after the first use of the word *Culter*, Basilewsky devoted an entire line to the words 'Cypr. cultratus Linn.' The case is clearly covered by the International Rules of Zoological Nomenclature, reference being made particularly to article 30, paragraph *g*, reading:

"If an author, in publishing a genus with more than one valid species, fails to designate or to indicate its type, any subsequent author may select the type.

"That Basilewsky did select a type species by 'indication' seems to be fully established by the international rules and the opinions thereunder, and Bleeker's action was void."

This is the whole of Dr. Smith's nomenclatural argument for considering *cultratus* the genotype by original designation of *Culter*, and I have quoted it in full. I omit his remarks on the definition of the genus, which are in this case relevant only zoologically and not nomenclaturally.

Dr. Smith's quotation of Article 30 II *g* of the *Rules* is quite incomprehensible to me. *Litt. g* is a part of Section II of Article 30, which section deals only with "cases in which the generic type is accepted not solely upon basis of the original publication." It is therefore applicable to Bleeker's subsequent designation (which is a valid act under it) but is not at all pertinent to Dr. Smith's argument that the type of *Culter* was fixed by original designation of Basilewsky.

To obtain a pertinent rule we must refer to Section I of Article 30, covering "cases in which the generic type is accepted solely upon the basis of the original publication." Therein *Litt. a* states: "When in the original publication of a genus, one of the species is definitely designated as type, this species shall be accepted as type, regardless of all other considerations. (Type by original designation.)" The acceptance of *cultratus* as the type by original designation of *Culter* depends wholly on this paragraph; the other paragraphs of Section I do not apply in the present case. The outcome therefore hangs upon one decision. Did or did not Basilewsky *definitely designate* a genotype for *Culter*? The

phrase "definitely designate as type" is very explicit. Plainly, mere citation as an "example" or even as a "typical example" does not suffice.

In the paper under consideration, Basilewsky established seven new generic names. Of these seven, four (*Leptocephalus, Cephalus, Eperlanus,* and *Osteoglossum*) were monotypic and therefore required no further genotype designation. Basilewsky made no statement concerning any of the four that might be considered type designation. To each of the three remaining new genera (*Nasus, Culter,* and *Apterigia*) Basilewsky referred more than a single species. It is from a study of these latter three genera that we must determine whether Basilewsky definitely designated generic types.

Nasus included a single new species, *Nasus dahuricus,* but directly below the generic name, and before mention or description of the one new species, Basilewsky devotes a separate line to: "(*Cypr. nasus* Linn.)." (This is exactly comparable to the citation of *cultratus* under *Culter.*) Was this or was this not intended to be a definite designation of generic type? Esoterically, it determines the genotype beyond any question, since under the present *Rules* (Article 30 I d) *nasus* becomes the type of *Nasus* by absolute tautonymy. But did Basilewsky have any clear idea of the principle of absolute tautonymy? More to the point and aside from tautonymy, did Basilewsky clearly intend to designate *nasus* as genotype? I do not think the bare facts regarding *Nasus* alone will enable us to decide, principally because the case is complicated by the intrusion of the present law of absolute tautonymy. For this reason, I do not believe that the case of *Nasus* necessarily prejudices that of *Culter.*

On the other hand, consideration of Basilewsky's new genus *Apterigia* throws considerable light on our problem. Under *Apterigia* Basilewsky describes three new species, *A. saccogularis, A. nigromaculata,* and *A. immaculata. But there is no parenthetical citation of any of them, or of a fourth species, below the generic name.* In other words Basilewsky made no genotype designation for *Apterigia,* and such designation rests with some later author. If he definitely designated the types of two of his three new genera which contained more than one species, why did he not designate a type for the third?

Upon reading Basilewsky's paper over it is not evident to me that he made use of the system of designating generic types, a system that was in wide but not general use during the period in which he wrote. For only two of his seven new genera does he give anything that could possibly be construed as a type designation. Moreover, it should be noted that in these two genera, the species cited parenthetically are well known European species. The remaining five are Asiatic genera with no representatives in Europe. In my opinion, there is no internal evidence in Basilewsky's paper to show that he intended the parenthetical mention of the two European, Linnaean species under *Nasus* and *Culter* as anything more than the citation of *European examples* of these genera, likely to be familiar to his preponderantly European readers. Such citations were common in the Linnaean period of zoology. That he meant to include these European species in his new genera is undoubted, but that he intended definitely to designate them as generic types is not evident.

It is evident, however, that he formed the new generic names *Nasus* and *Culter* from the Linnaean specific names *nasus* and *cultratus.* Indeed, it may be that the two parenthetical citations were as much explanations of the derivations of the two new generic names as they were anything else. This brings us to the consideration of tautonymy.

After deciding that Basilewsky originally designated *cultratus* as the type of *Culter,* Dr. Smith attempts to show that, provided Basilewsky did not originally designate a type, *cultratus* must still be the type of *Culter* by "virtual tautonymy." To prove his point he quotes Article 30 III i of the *Rules.* Dr. Smith's quotation of this paragraph is clearly irrelevant and his argument based upon it therefore has no merit. In the first place, Section III of Article 30 deals only with cases in which the generic type is *selected by a subsequent author* and not at all with those in which genotypes are *accepted upon the basis of the original publication.* In the second place, Section III of Article 30 consists merely of recommendations, and not of mandatory provisions of the *Rules.* These recommendations are no more than precepts to guide those who must make type designations for genera *for which no type has been selected.* Again we must refer to Section I of Article 30 in order to obtain a pertinent rule. But in Section I the only provision for tautonymic type recognition is *Litt. d,* which deals with absolute tautonymy. In other words, the *Rules* do not recognize the principle of "virtual tautonymy" in cases where the generic type is accepted solely upon the basis of the original publication. Since Dr. Smith

is arguing for type acceptance solely upon the basis of Basilewsky's paper, his argument collapses.

I can see no escape from the conclusion that Basilewsky did not designate a generic type for *Culter*. Bleeker's designation of 1863 therefore stands, and *Culter alburnus* Basilewsky, 1855, is the genotype of *Culter*.

It may be remarked parenthetically that the late Dr. Jordan's discussion of Basilewsky's new genera (Jordan, Genera of Fishes, 2: 262) contains some inaccuracies, at least in the light of present-day usage of the type terms orthotype and logotype. Under present interpretation the type of *Nasus* is determined by absolute tautonymy and not by orthotypy, of *Leptocephalus* by monotypy and not logotypy, of *Cephalus* by monotypy and not by orthotypy, of *Culter* by logotypy (subsequent designation), of *Eperlanus* by monotypy and not orthotypy, of *Osteoglossum* by monotypy and not logotypy, and of *Apterigia* by logotypy.

It is fortunate that Bleeker's designation of *alburnus* holds, since under Dr. Smith's arrangement the well-known name *Culter* would disappear as a synonym of *Pelecus*. In spite of some disagreement as to the zoological definition, *Culter* has been used continuously for a genus since Basilewsky's time, by all workers on Chinese fishes. Günther, Bleeker, Kner, Sauvage and Dabry, Berg, Nichols, Rendahl, Chu, and others—in all the most important works on Chinese fishes, have used the genus, and on quick perusal I find none who has given a formal description of *Culter alburnus* has excluded that species from *Culter*, albeit some have applied different limits to the genus. The suppression of *Culter* and its replacement by a little known name would therefore be unfortunate.

The fact that there has been disagreement regarding the identification of specimens with Basilewsky's description of *Culter alburnus* is a zoological matter totally divorced from the purely legal, nomenclatural aspects of the case, even though the present application of the generic name *Culter* depends on such identification. As a matter of fact, I see no difficulty in placing *Culter alburnus*, since its type specimen in the Leningrad Museum (No. 5585) has been re-examined and redescribed by a thoroughly competent authority on the fishes of Northern China and on the family Cyprinidae, Dr. L. Berg (Mém. Acad. Imp. Sci. St. Pétersbourg, ser. 8, 24, 9, 1909: 139). Dr. Berg has also described and figured *C. alburnus* in the third edition of his monumental *Les Poissons des Eaux Douces de L'U. R. S. S.* Why Dr. Smith should apparently believe that recourse to Günther's British Museum specimens, none of which had anything to do with Basilewsky's type material, would tend to discredit the results of Berg's study of the actual type of *Culter alburnus*, it is difficult to see. No one will hold that any investigator is infallible, but until another author has re-examined Basilewsky's type in Leningrad and proved Berg's conclusions to have been in error, we must accept those conclusions at their face value.—GEORGE S. MYERS, *Natural History Museum, Stanford University, California.*

ON *CITULA CILIARIA* RÜPPELL.—In identifying a puzzling specimen of *Citula* obtained from Bali by the American Museum Lerner Expedition, I have had reference to Wakiya's analysis of the oriental forms (1924, Ann. Carn. Mus., XV: 167–182, plates). His *Caranx* (*Citula*) *armatus* (Fig. 1, 123 mm. standard length), *schlegeli* (Fig. 2, 77 mm.) and *plumbeus* (Fig. 3, 144 mm.), Plate XX, all seem to be age stages of *Citula armata* (Forskal). Our specimen will fit either his *Caranx* (*Citula*) *ciliaris* or *uii*, in fact is somewhat between the two, and their differences seem too slight to be significant. From reference to the type description and figure of *Citula ciliaria* Rüppell (1828, Atl. Fische Nordl. Afrika: 102, Pl. 25, fig. 8) it is probable that this is the fish in question, and I am here identifying the Bali specimen with, and considering *Caranx uii* Wakiya a synonym of it. *Citula ciliaria* Rüppell is made a synonym of *armata* by Weber and de Beaufort, 1931, and if it is unidentifiable *uii* becomes available.

There is but scant representation in the American Museum collections of species related to *Citula armata* with exserted and notably lengthened initial dorsal filament. This Bali specimen of *C. ciliaria* measures 140 mm. standard length, and a similar smaller specimen of 112 mm. referable to the same form, is from Toba Market, Japan (Nov. 20, 1922, D. S. Jordan and Yamamoto). Two Japanese *C. dinema* (Bleeker) of 140 to 141 mm. have the same data as the above. There is a *C. oblonga* (Cuvier & Valenciennes) of 138 mm. from Bali (Lerner Expedition); and a *C. armata* (Forskal) of 84 mm. (referable to *schlegeli* Wakiya) from Batavia, Java (collected by Owen Bryant, April 2, 1909).

The *C. oblonga* is at once separable from the others by its slenderer body (depth in standard length, 2.6), longer straight part of lateral line (about equal to the chord of the curve), and more numerous developed scutes (39). It has 21 dorsal and 19 anal soft rays, 18 gill-rakers on the lower limb of the arch, only a faint dusky blotch on the upper corner of the gill cover, and pale ventrals.

The 5 specimens representing *Citula armata, ciliaria* and *dinema* are deeper and more compressed (depth in standard length, 1.6 to 2.1), and with a relatively long lateral line curve (its chord in straight part, 0.6 to 0.8). The three seem quite distinct, but might be confused. The *C. armata* has 22 gill-rakers on the lower limb of the first arch, whereas the other 4 specimens have only about 16, a significant difference to separate this form if, as is possibly the case, its relatively short anal filament does not hold in large specimens.

The two *C. dinema* have scutes relatively strong, 24 to 25 developed versus 13 to 16 in the others. They have 18 to 19 dorsal and 16 to 17 anal soft rays, versus 21 dorsal and 18 anal in the other three specimens. They are less deep-bodied than the *C. ciliaria* of comparable size, with little difference in the greatest depth (2.1 versus 1.9), but they are considerably less deep at the shoulder; and their teeth are notably larger. They have faint cross-bands, a bold opercular blotch, and the ventrals more or less blackish terminally.

The two *C. ciliaria* have standard length 112, 140 mm.; depth in this, 1.6, 1.9; head, 3, 3.1; dorsal lobe, 2, broken; anal lobe, 2.7, 2.8; eye in head, 3.9, 3.8; pectoral, 0.9, 0.8; greatest width, 2.2; curve lateral line in straight part, 0.6; teeth fine; no evident cross bands, ventrals pale, a vague opercular blotch in the larger and none in the smaller specimen.

Caranx plumbeus, Jordan and Seale, 1906 (Bull. Bur. Fish., XXV: 233, fig. 28, Samoa), seems to be *Citula ciliaria*. *Caranx rastrosus* Jordan and Snyder, 1911 (Mem. Carn. Mus., IV: 37, Pl. LI, Formosa) may be *C. armata* if the anal filament becomes longer in this form at large size, or a distinct form. Whereas other species close to *Citula armata* have been named in the literature and confuse the synonymy, I find only the four in the following key to present tangible differences.

(1) Scutes comparatively well developed, occupying essentially the whole length of the straight part of lateral line, about 25 in number; dorsal soft rays 18—19, anal 16—18; teeth rather coarse. *dinema*

Scutes weak, not occupying the whole length of the straight part of the lateral line, 13 to 20 developed; dorsal soft rays, 20—23, anal 16—19. see (2)

(2) Anal lobe short, when filamentous much shorter than dorsal; gill-rakers on lower limb of first arch 21—22. *armata*

Anal filament long, comparable with though shorter than dorsal; anal lobe with filament, less than thrice in standard length. see (3)

(3) Gill-rakers on lower limb of first arch about 22. *rastrosa*

Gill-rakers on lower limb of first arch about 16. *ciliaria*

The genus *Citula* Cuvier (type *Sciaena armata* Forskal), here recognized, is one of convenience. Its typical species are distinct enough, but closely related to *Caranx*, and there are others intermediate between these and *Caranx* or *Carangoides*.—J. T. NICHOLS, *New York, New York.*

SYNBRANCH EEL IN ANT NEST.—The American Museum of Natural History has recently received a small synbranch eel, *Synbranchus marmoratus* Bloch, about 220 mm. long, from Dr. D. C. Geijskes of the Agricultural Experiment Station, Paramaribo, Surinam, which, to quote the accompanying letter, was "found about 8 feet under the ground's surface in one of the smaller holes in a large ant nest, of *Atta sexdens* (Linnaeus). Under the ant nest many holes, by which the ants take water for their fungus gardens, are so constructed that they go down into the wet clay beneath." In this ant nest, on a sand hill at least four hundred meters from the nearest swamp, which was "entirely dried up" at the time, two of these eels were found in such water holes which they fitted nicely, and where the clay wall was green with algae. This particular nest was one of 6, 2 of *Atta sexdens* and 4 of *Atta cephalotes*, that were dug up.

The unusual observation seems worth placing on record. A color sketch of the eel in life shows it to have been dark coffee brown, mottled with black along the sides of the back, except near the head.—J. T. NICHOLS, *New York, New York.*

CORRECTIONS ON TWO NEW GENERA AND THREE NEW SPECIES OF CHEILODIPTERID FISHES, WITH NOTES ON THE OTHER GENERA OF THE FAMILY.—Additional studies made on the Cheilodipterid fishes at the suggestion of Mr. J. R. Norman of the British Museum indicates that certain changes are necessary in my recent paper in the Proceedings of the U. S. National Museum (1940, 88: 403-423). *Telescopias*, pp. 406 and 422, should be placed in the synonomy of *Scombrops*, pp. 407 and 422, because from further examination of material, *Telescopias* has 3 anal spines, the first only visible by careful dissection, and there are a few small villiform teeth posteriorly on the maxillary even in large specimens, thus the differences in dentition of figures 19b and 19c, p. 415, may be an age character since *Telescopias* was based on large specimens.

My genus *Jadamga* must be replaced by *Paramia* Bleeker as the genotype of both is *Cheilodipterus quinquelineatus* Cuvier and Valenciennes. In Jordan's *Genera of Fishes* the genotype of *Paramia* is incorrectly given as *Cheilodipterus lineatus* Lacépède.—Leonard P. Schultz, *U. S. National Museum, Washington, D. C.*

MOSQUITO LARVAE AS PIPE-FISH FOOD.—For several years I kept a number of fresh-water pipe-fish in aquaria in Manila. The oblong tanks of concrete, with glass sides, were from a meter and a half to two meters long, and a little less than a third of a meter wide and deep. They were kept outdoors, and of course mosquitos laid their egg rafts in them throughout the year. The tanks never had any mosquito larvae in them, from which we inferred that the larvae were devoured by the pipe-fish as fast as they were hatched. We never saw the pipe-fish actually eat mosquito wigglers.

Recently Mr. M. W. F. Tweedie, of the Raffles Museum, Singapore, has kept pipe-fish in his aquaria at home. As pipe-fish are difficult to feed, Mr. Tweedie tried giving them mosquito larvae. To his delight he found they eagerly devoured the wigglers, and his feeding problem was solved. Mr. Tweedie and I found the species he uses in a rather rapidly flowing creek in rolling country in Johore, where it inhabited clumps of algae. I determined the species as *Doryichthys martensi* (Peters).

The pipe-fish I kept in Manila were taken from the Pasig River, 5 or 6 miles from the sea. They were mostly *Syngnathus djarong* Bleeker, but at times I had *Doryichthys retzii* (Bleeker) and *Microphis manadensis* (Bleeker).

We may therefore include fresh water pipe-fish of several species among fishes of larvicidal value in the control of malaria.—Albert W. C. T. Herre, *Natural History Museum, Stanford University, California.*

TWO RECENT RECORDS OF *ZAPRORA SILENUS* JORDAN FROM THE ALEUTIAN ISLANDS.—According to Chapman (Chapman, W. M., and L. D. Townsend, 1938. The osteology of *Zaprora silenus* Jordan, with notes on its distribution and early life-history. Ann. Mag. Nat. Hist., Ser. 11, 2:89), in 1938 the total number of specimens of *Zaprora silenus* known to science was thirteen. The range of the species was established from the Strait of Juan de Fuca on the south to Akutan Island, Alaska, on the north and west.

Two additional specimens now in the United States National Museum were collected by the Bureau of Biological Survey in 1937 and identified by Dr. L. P. Schultz.

An adult specimen (Field No. 61 VBS), collected at the mouth of Chichagof Harbor, Attu Island, on June 8, 1937, extends the range to the westward by approximately 700 nautical miles.

A second specimen, immature (Field No. 15 VBS), was collected by O. J. Murie and the writer a quarter of a mile off Nikolski Harbor, Umnak Island, on August 23, 1937. It was hovering about a foot beneath the trailing tentacles of a large orange jellyfish (*Cyanea* sp.), where it maintained its sheltered position and followed the movements of the medusa. So closely was the fish associated with the medusa that when a boat was put alongside and the medusa picked up with a dip net it was at first thought that the fish had escaped, but closer scrutiny revealed that the fish had sought protection among the lobes of the manubrium. When first seen in the water from above, the color of the fish matched exactly that of the medusa, owing to the reflection of orange light, but removed some distance from the medusa, the back and sides of the fish appeared olive-gray and the belly white.—Victor B. Scheffer, *U. S. Biological Survey, University of Washington, Seattle, Washington.*

Herpetological Notes

"SONORA" AS THE LOCALITY OF THE GRAHAM-CLARK REPTILE COLLECTIONS OF 1851.—In Gloyd's splendid monograph of *The Rattlesnakes* (Chicago Academy of Sciences, Special Publication, No. 4, 1940: 41) I find a statement with regard to the locality of one of the paratypes of Baird and Girard's *Crotalophorus edwardsii* (Cat. North Amer. Rept., pt. 1, 1853: 15) which if not quickly corrected threatens to cause reckless and erroneous changes in our herpetological nomenclature. The statement is as follows:

> The occurrence of this form [the western massasauga] in Mexico is doubtful. Baird and Girard (1853, p. 15) listed . . . a third [specimen] from "Sonora" . . . The last, USNM. 506, bears a parchment tag which indicates that it was collected near Sonora, Sutton County, Texas.

The facts in the case are as follows: In the original description, as quoted above, the data relating to the specimen in question are given thus:

> Sonora 145. 26. 23. 8½. 1⅛. Col. J. D. Graham.

The significance of the numbers is explained thus by the authors (p. viii): the first indicates the number of ventrals; the second is that of the subcaudals; the third the number of rows of scales around the body, exclusive of the ventrals; the fourth shows the entire length of the animal; and the fifth the length of the tail, in English inches.

The specimens received from Col. Graham were collected by Mr. J. H. Clark, attached to his staff, during their connection with the survey of the Mexican boundary in 1851. The collection was sent by Graham to the Smithsonian Institution in 1852, and the many new species were at once described by Baird and Girard.

The collections of the Museum at that time were not registered and numbered. The original Museum catalog was not started by Baird until January 24, 1856. In this register, in Girard's handwriting on January 26, 1858, under numbers 505 to 509 are five specimens entered as follows:

505	[Crotalophorus] Edwardsii	Brazos R. Tex.	Dr. Shumard
506	" "	Sonora	D. Graham
507	" "	Tamaulipas	Dr. Edwards
508	" "	Texas	Genl. Churchill
509	" "	Mexico	Dr. Edwards

It is to be noted that neither in the original description (1853) nor in the original entry in the register (1858) is the locality Sonora qualified; also that the specimen from Tamaulipas, the type of *C. edwardsii*, is given the number 507, which it still bears on the shelves of the National Museum (and not 509 as inadvertently stated by Gloyd).

No. 506 is the third specimen listed in the original description of 1853. It has two old parchment labels (not one as stated by Gloyd). The first label, like those of most of the specimens listed in 1853, has the string stitched on the skin near the end of the tail. Evidently attached in 1852, it contains the single word Sonora and the scale count identical with that of the original description, and appears to be in Girard's handwriting. The other parchment label, tied around the neck, is inscribed "506 Sonora Tex Dr. Graham" in the same handwriting as the entry in the record book, the "Tex" on the label identical with the Tex. in the book under No. 505.

It is perfectly evident that the recorder, Girard, in writing the label for No. 506 inadvertently dittoed the "Tex" of the line above, just as he dittoed the "Dr" of Dr. Shumard in place of the "D" of D. Graham (the first initial, J, omitted in the record book).

The above case has an apparent bearing on all the other specimens collected by Graham-Clark on their Sonoran trip to Santa Cruz and return to the Cobre mines. The route of this expedition zigzagged during most of the month of September over what is now the region of the international boundary between Arizona and Sonora, but which in 1851 was still entirely within the Mexican state of Sonora. It may therefore not be out of place to note, as many type specimens of well-known species are involved, that all the numerous specimens recorded from this trip are simply labeled Sonora without any qualification. Thus, only to mention an example, the unique type of *Salvadora grahamiae*, USNM. No. 2081, has for locality only Sonora. In this case the parchment labels are missing, but near the end of the tail the marks of the stitch are plainly visible.

To clinch the matter it may finally be stated that no locality with the name Sonora existed in what is now Sutton Co., Texas, in 1851. As a matter of fact, the name was given as late as 1889 by Mrs. Charles F. Adams to a town site started by her husband in 1888 "on a dry draw of Devil's River 40 miles from water in every direction." Her son, Mr. Ica C. Adams, now postmaster of Brawley, California, has kindly informed me that his mother "selected it because she liked the name; she liked the word and the way it sounded."—LEONHARD STEJNEGER, *United States National Museum, Washington, D.C.*

PINE SNAKES, BLACK AND BROWN.—I have just been reading Dr. Francis Harper's masterly paper upon the work of Bartram and others, in the *American Midland Naturalist* (23 [3], July [May], 1940: 718).—It occurs to me that there is one fact which should be kept in consideration affecting the names of the pine snake, *Pituophis melanoleucus* (Daudin) and *P. mugitus* Barbour. The point is that whatever Bartram's recollections of the case may have been as stated in the unpublished article on the snakes of east Florida, to which Harper refers as settling the type locality of *P. melanoleucus*, it is quite evident that Bartram erred.

Bartram, in the "Travels" (New York, 1940: 171), says:

> I observed several large snakes entwined together. I stepped up near them; they appeared to be innocent and peaceable, having no inclination to strike at anything, though I endeavored to irritate them, in order to discover their disposition; nor were they anxious to escape from me. This snake is about four feet in length, and as thick as a man's wrist; the upper side of a dirty ash colour; the squamae large, ridged, and pointed; the belly or under side of a reddish dull flesh colour; the tail part not long, but slender, like most other innocent snakes. They prey on rats, land frogs, young rabbits, birds, etc.

Here I believe Bartram saw the Florida pine snake. Later, speaking of the species of snakes in the region of Florida and Carolina, he says of the pine snakes:

> They are the largest snake yet known in North America, except the rattle snake, and perhaps exceed him in length; they are pied black and white; they utter a terrible loud hissing noise, sounding very hollow and like distant thunder, when irritated, or at the time of incubation, when the males contend with each other for the desired female (page 228).

These quotations make it appear that Bartram had seen both forms of the pine snake but never connected one with the other. Rereading Bartram reveals a number of bits of evidence that most of what he wrote he wrote from memory, with the aid of field notes, and, one would suspect, without having kept an actual day by day diary. Of course I may be incorrect in this surmise—Dr. Harper would know.

Brown pine snakes occur throughout Florida, and in parts of Georgia and South Carolina, but no black and white pine snakes occur in Florida. Enough specimens have been observed and collected to settle this fact with apparent certainty. No brown pine snakes occur in New Jersey, by the same token, though both forms occur together in the mid-zone of the Atlantic east coast. That is why it is wise, I think, to let these two forms stand as binomials, as in the last *North American Check List* of Stejneger and Barbour. To sink *mugitus* in the synonymy of *melanoleucus*, as Dr. Harper suggests, is not a momentous matter but it would be unexpedient in view of the facts of the case, and since another new name would then have to be set up for the black and white form. No other name could be found as explicate and descriptive as *melanoleucus*.

When a black and white pine snake turns up in east Florida will be time enough to insist on the change.—THOMAS BARBOUR, *Museum of Comparative Zoology, Cambridge, Massachusetts.*

NORTHERN CRESTED LIZARD COLLECTED IN UTAH.—For a number of years attempts have been made to find the northern crested lizard, *Dipsosaurus dorsalis dorsalis*, in Utah. Woodbury (Reptiles of Utah, 1931, Bull. Univ. Utah, 21 (5): 22) indicated its proximity to the southwestern corner of the state, but all attempts to locate individuals in Utah heretofore seem to have been fruitless.

On April 6, 1940, a party including the authors traversed the Beaver Dam Wash from the Utah-Arizona state line northward for a few miles. During the warm late afternoon, both young and adult specimens were collected in the soft, sandy soil west of the wash. This definitely establishes the extension of the range of this lizard up the Virgin River drainage into the southwest corner of Utah, which appears to be its extreme limit in this direction.—ANGUS M. WOODBURY, *University of Utah*, and ROSS HARDY, *Dixie Junior College, Salt Lake City, Utah.*

Reviews and Comments

THE RATTLESNAKES, GENERA *SISTRURUS* AND *CROTALUS*: A STUDY IN ZOOGEOGRAPHY AND EVOLUTION. By Howard K. Gloyd. Special Publ. Chicago Acad. Sci., 4, 1940: VII + 266 + [4], figs. 1–10, pls. 1–31, tables 1–22. $2.50.—American herpetology has received a notable addition in the publication of Dr. Howard K. Gloyd's long-awaited monograph on the rattlesnakes. This is in the best tradition of the generic revisions exemplified, among the snakes, by Ruthven's *Garter snakes*, Blanchard's *King snakes*, and Ortenburger's *Racers*, and represents a monument to industry and patience.

The scope of the work is best described in the author's own words: ". . . to review and revise the systematics of the rattlesnakes; to define and describe the species and subspecies; to bring together insofar as possible all information concerning the distribution and variation of each form; to indicate the probable genetic relationships of the species and subspecies of the genus *Sistrurus* and a portion of the genus *Crotalus* (the *triseriatus* and *durissus* groups); and finally to point out the most conspicuous evolutionary tendencies among the rattlesnakes, and the probable center of origin of the group as a whole."

The work begins with a historical summary of prior taxonomic work on the two genera, a discussion of materials and procedure, and a key. Then follows a series of complete specific or subspecific descriptions, with group discussions and tabular summaries. Certain groups were selected for more complete treatment than others, and in these each subspecies is represented by full material under the following headings: synonymy, description, locality records, variation, and affinities. Each such subspecies also includes a spot map, showing the localities of available specimens. The subspecies, in groups less fully discussed, are adequately summarized. Under each group will be found conclusions respecting relationships, with cross-hatched maps and phylogenetic diagrams. The work concludes with a general summary discussing such items as the rattle, size and form, scutellation, coloration, specializations, and center of origin and dispersal. There is an extensive bibliography. Habits, field notes and life histories are not included, since they are considered beyond the scope of the work.

In nomenclature Dr. Gloyd introduces the following modifications. Two new subspecies of *C. triseriatus* are described—*C. t. anahuacus*, from the southeastern part of the Mexican Plateau, a subspecies falling between *C. t. triseriatus* and *C. t. omiltemanus;* and *C. t. miquihuanus*, a form closely allied to *C. t. pricei* and occurring in Tamaulipas and Nuevo Leon. *Crotalus scutulatus* is divided into subspecies by the recognition of *C. scutulatus salvini* of Günther, 1895, this subspecies occupying the extreme southeasterly limit of the range. Dr. Gloyd returns to *C. atrox* as proper name for the western diamond rattlesnake, since the first publication of the earlier name, *C. cinereous* of LeConte in Hallowell, 1852, was not italicized. *C. v. decolor* is preferred to *concolor* on the theory that the latter is preoccupied by a *nomen nudum* of Jan, 1859, which was placed in the synonymy of *horridus* by Garman, 1883. This decision involves a highly technical point since Garman used a question mark in applying this allocation of *concolor*, as did Stejneger, 1895. In the absence of the question mark, Dr. Gloyd would have conclusive authority for preferring *decolor*. Parentheses have been omitted around the describer's name, even when included by the describer under a different genus from that now recognized. There is a modern tendency to discard these parentheses altogether.

The only important issue which this reviewer would take with Dr. Gloyd relates to some of the groupings of species. For example, I do not consider *horridus* and *molossus* as closely related to the *durissus* group as indicated; *lucasensis* rather than *ruber* is more closely related to the ancestral *atrox;* and not enough importance has been assigned to the differences between the hemipenes of *triseriatus* and *lepidus*. In

fact, the hemipenes do not seem to have been given much weight in determining some of the phylogenetic positions. The peculiar character of the hemipenes of *lepidus,* which are intermediate in structure between those of the more typical *Sistrurus* and *Crotalus,* is not mentioned. Occasionally conclusions with respect to geographic variations are premised on samples too small to warrant the assumption of significant differences.

Dr. Gloyd has been fortunate in his facilities for publication, and in this his readers share. There is a large volume of tabular matter on the species in which he has specialized, with full synonymies and lists of localities and specimens examined. Data of this character are often of great importance in carrying subsequent research forward, but, with the large collections now available, few authors are allowed the space wherein to include them. There are 31 half-tone plates, most of which represent photographs of live specimens, the majority of forms being included. A few of the rare subspecies are presented by means of well-executed sketches. The only criticism which may be leveled at the photographic figures lies in the failure to label the preserved specimens as such; also the figure of *C. unicolor,* not one of Dr. Gloyd's excellent photographs, tends to exaggerate the lightness. Mechanically, also, the book is deserving of great commendation. The binding and paper are serviceable, and these are matters of importance in such a work, which will be so often used for reference. Maps and other figures show expert draftsmanship. In both synonymies and locality records various type faces have been judiciously used to enhance clarity. The proof reading has been excellent.—L. M. KLAUBER, *San Diego Society of Natural History, San Diego, California.*

CARIBBEAN TREASURE. By Ivan T. Sanderson. The Viking Press, New York, 1939: 1–292, 32 illus. $3.50.—As its title implies, this book is a companion volume to Sanderson's *Animal Treasure,* which recently aroused such a furore among his scientific colleagues. Like its predecessor, *Caribbean Treasure* is destined to find naturalists divided into violently opposed camps, for the author's style and approach to his subject are the same although startlingly unorthodox statements on subjects that are likely to arouse naturalists are much less frequent.

Caribbean Treasure recounts the highlights of more than a year of field work in Jamaica, Trinidad, Haiti, and Dutch Guiana. Much of the book deals with mammals, although ichthyological and herpetological items are not lacking. Astounding among the latter is the discovery that a lizard (*Protoctoporus shrevei*) found on Trinidad has a row of luminescent spots on the side of the body. This observation, which was independently verified by H. W. Parker of the British Museum, is easily the most remarkable that Sanderson has made.

The author has illustrated the book with drawings done by the same striking and peculiarly characteristic pencil technic as those used in *Animal Treasure.* These are largely of mammals, and most of them are excellent. The reviewer is strongly opposed to the useless coining of new popular names when wholly satisfactory ones have already been established, and finds their frequent occurrence in *Caribbean Treasure* annoying. Thus, the vampire bat becomes the "blood-lapping bat," the marsupial frog is called the "pouch-back frog," the three-toed sloth is altered to the "three-fingered sloth," etc.

Recently it was the reviewer's privilege to spend several days with Mr. Sanderson and his charming wife at Belize, British Honduras. First-hand contact with his spontaneous enthusiasm and discussion of his ideas and methods throw considerable light on what some of his critics have regarded as heresy. There can be no doubt that Sanderson occasionally allows himself to be carried off by his zeal. Thus, his speculations on the feral horses of Haiti are ridiculous. The reviewer, however, is wholly in sympathy with his subordination of the mere accumulation of quantities of tagged specimens to extensive studies of habits, behavior, and ecological relationships. This program is rounded out with the systematic preservation of selected anatomical material and extensive photography. Anyone not exclusively interested in the minutiae of taxonomy might well wish that more popular natural histories had such a background as this, and it is the reviewer's hope that the proceeds from *Caribbean Treasure* may be sufficient to finance further zoological field work.—D. DWIGHT DAVIS, *Field Museum of Natural History, Chicago, Illinois.*

A FIELD BOOK OF NORTH AMERICAN SNAKES. By Raymond L. Ditmars. Doubleday, Doran and Company, Inc., New York, 1939: XII+305 pp., 49 pls., $3.50.—Dr. Ditmars' books about snakes and about reptiles in general have performed a genuine service in combating popular prejudice against these creatures and in promoting interest in them. The *Reptiles of North America, Reptiles of the World,* and *Snakes of the World* continue to serve their useful purpose as reference works for amateurs. The appearance of still another book about snakes, which makes no pretense of adding to our knowledge of the group, warrants a more critical reception. A volume directed at amateur students should include some indications of the large gaps in our knowledge, with suggestions for the *study* of snakes, which is so different from talking about them. The author's chatty personal reminiscences, which formed a charming part of his earlier books, are a bizarre and incongruous adornment to a "field book."

The title is a misnomer, in that one expects a field book to be smaller in format. The size could have been considerably less if the division of the country into sections had not led to repetition, often word for word, of descriptions of the many species that are not confined to one section. The information on habits is not repeated in these cases, and it is a serious mechanical defect that the necessary cross reference is to the chapter only instead of to the specific page. It is exasperating to the meticulous that the book nowhere defines "North America" as exclusive of Mexico and Central America. The opening sentence "Brief study of the map accompanying this chapter. . . ." leads one to expect some geographic definition, but the promised map is wanting. It is one of the functions of a check list to afford an authority on nomenclature which popular writers may follow. The present work might have been brought into agreement with the fourth edition of the *Check List of the Amphibians and Reptiles of North America* by a delay of only a few months. The segregation of the illustrations in a separate section at the back of the book, which greatly reduces the publisher's costs, is so unsatisfactory a form for a work of this kind that the publisher's defense of the practice (on the jacket) reads like an attempt to forestall criticism. The illustration of color patterns by means of photographs of sections of the bodies of snakes is excellent in plan, but it may be pointed out that the photographic work is inferior. There is no good excuse for out-of-focus figures or for the shadows which mar so many of the plates.

The reviewer is astonished on every page by extraordinary grammatical constructions and equally remarkable misuse of words. These seem to be due to an attempt to combine the abbreviated form of technical literature with what the author regards as readability, with natural resultant failure. We read, in a casually chosen example, that "Southwestern North America is the headquarters or congregation of the species of rattlesnakes, whence they radiate northward, eastward and southward in diminution of species, though the respective kinds ranging far from the center of maximum occurrence of species retain strong occurrence in numbers." A key for identification is referred to as a "deductive listing." Or, we find on p. 75, about poisonous snakes, that "there are but four types, which the average observer would *deduct* as such without *contact* to formal descriptions. . . ." (italics by the reviewer).

Putting aside the temptation to animadvert further on the Ditmarsian style, the reviewer seizes the opportunity to discuss the hoary misstatement (which Mr. Ditmars even *defends*) that there are four "types" of poisonous snakes in the United States, (1) coral snakes, (2) the copperhead snake, (3) the water moccasin, and (4) rattlesnakes. This current piece of misinformation depends on a confusion of mere words or names with the concept of "kind" or "type." There are, obviously *two* principal types of poisonous snakes in the United States, the coral snakes and the pit-vipers; or, if one wishes to define kinds or types as *genera,* there are five kinds of poisonous snakes within our limits, two of coral snakes, two of rattlesnakes, and only one for the closely allied water moccasin and copperhead. By no stretch of definition of the word "type" can the copperhead and moccasin rank as distinct types while the *genera* of coral snakes and of rattlesnakes are lumped. If we define "types" as *species,* there are *nineteen* listed for the United States in the current check list. It is quite correct, however, to state that there are four popularly current *names* for the poisonous snakes of the United States.—Karl P. Schmidt, *Field Museum of Natural History, Chicago, Illinois.*

A REVISION OF THE BLACK BASSES (*MICROPTERUS* AND *HURO*) WITH DESCRIPTIONS OF FOUR NEW FORMS. By Carl L. Hubbs and Reeve M. Bailey. Misc. Publ. Mus. Zool., Univ. Mich., No. 48, 1940: 51 pp., 1 text fig., 7 tables, 6 plates, 2 maps.—This is a scholarly analysis of present knowledge of the forms of black basses, seven of which are recognized, and a chart of their theoretical phylogeny figured. The large-mouth bass, for which the genus *Huro* is recognized in conformity with recent American usage, appears to be distinct and indivisible. The "small-mouthed" basses, genus *Micropterus* (sensu stricto), on the other hand, are very variable, and of these three species, one of two, another of three geographic subspecies, are recognized. The interrelationship and probable phylogenetic significance of the forms involved is thus emphasized.

The so-called spotted bass is found to occur in the range of the typical small-mouth, though not so far to the north, and both are represented by recognizable races at or near the western edge of their range in Oklahoma. To the southeast in Alabama there is another (third) recognizable race of the spotted bass, and also the so-called red-eyed bass, described as a distinct species.

In 1888 Goode (American Fishes: 54) wrote: "Until recently we supposed there were many kinds of Black Basses. . . . Twenty-two separately named species are on record. In 1873, Prof. Gill, after studying specimens gathered from all parts of the United States by the Smithsonian Institution, came to the decision that there were only two species, the Large-mouthed and the Small-mouthed bass." This view was generally accepted as satisfactory by ichthyologists and sportsmen until 1927, when Dr. Hubbs renamed a fish closely related to the small-mouth but in certain superficial characters resembling a large-mouth bass. From the present review of the problem it seems that where there had been so much smoke there was at least some fire.

Fishes are very plastic, some more than others, and recent studies indicate that many species are composites of at least statistically differentiable populations, the interrelationships of which it is often difficult to fit into a preconceived pattern. It is certainly interesting and may prove of considerable theoretical importance to investigate these minor variations; though the line where they become sufficiently definite and of sufficient magnitude to be advantageously recognized in nomenclature can only be determined by individual opinion. The different small-mouthed basses seem to the reviewer rather close to this line.—JOHN TREADWELL NICHOLS, *American Museum of Natural History, New York, N. Y.*

WONDER CREATURES OF THE SEA. By A. Hyatt Verrill. D. Appleton–Century Company, New York, 1940: 272 pages, 36 figs. $3.00.—A popular book on science must have a clear-cut purpose other than merely to produce another book. It may elucidate its subject in untechnical language for those who seek knowledge without wishing to do very extensive reading; it may help to make painless the identification of species and therefore give people an interesting hobby; or it may merely be literary, and transport its readers into the realm of poesy.

Mr. Verrill's book falls into none of these categories. Such literary quality as it might possess is nullified by its lack of scientific dependability, as exemplified by the following passage:

> The solution of the problem [of rearing baby lobsters] led to the creation of an entirely new profession—that of teaching baby lobsters to dive, and today every lobster hatchery has its experts whose sole occupation is to propel young lobsters down chutes until they learn to dive for themselves. Thanks to the artificial propagation of lobsters and lessons in compulsory diving, the delectable crustaceans have increased and multiplied enormously within the past few years. Strict laws regulating the taking of lobsters are in force, and although it is necessary to maintain the numerous hatcheries and to release millions of trained diving lobsters every year in order to maintain the lobster population of our coast, lobsters are again reasonably abundant and cheap.

—L. A. WALFORD, *Stanford University, California.*

THE WORLD UNDER THE SEA. By B. Webster Smith. D. Appleton–Century Company, New York, 1940: 230 pages, $3.00.—In contrast to the above, *The World Under the Sea* is an excellent account of the biology, chemistry, and physics of the ocean. It is an example of how knowledge can be told in a straightforward, simple fashion, and, at the same time, be made thoroughly interesting. The book is exceedingly well illustrated.—L. A. WALFORD, *Stanford University, California.*

BRAIN AND BODY OF FISH—A STUDY OF BRAIN PATTERN IN RELATION TO HUNTING AND FEEDING IN FISH. By H. Muir Evans, M.D. (Lond.), F.R.C.S. (Eng.). The Blakiston Company, Philadelphia, and the London and Norwich Press, Limited, St. Giles Works, Norwich, 1940: 164 pp., 9 figs., 29 plates. $2.00.—This book, as is indicated by the sub-title, is concerned mainly with an attempt to correlate brain pattern with diet and habitat in certain fishes—notably, some of the cyprinoids, Clupeidae, Mormyridae, Heterosomata, Gadidae, Merluciidae, and Anguilla. There are also chapters of more or less extraneous material, such as those on "The Silence of the Sea and the Voice of Fishes," and "The Problem of Pain in Fishes." The basis for much of this work is to be found in a series of papers published by the author mostly in the last decade in the Proceedings of the Royal Society of London (Ser. B, Vols. 108, 111, and 117).

It has been pointed out by C. J. Herrick that: "The correlation of habits of fishes with their anatomical structure is an easily accessible problem, and there is no point at which it can be attacked that will not yield new and interesting results. The field has scarcely been explored at all." (Bhimachar, Proc. Roy. Soc. of London, Ser. B, CXXIII, 1937: 60). The present work should, therefore, be of especial import.

These is no question that Evans has succeeded in demonstrating a reasonable degree of correlation between the brain pattern and the diet and habitat of certain groups of fishes. This is perhaps best illustrated in the cyprinoids, where the bottom-feeding forms have enlarged vagal and facial lobes, the surface-feeders have large optic lobes and smaller vagals and facials, and the brain of the plankton-feeders is characterized by its strikingly different pattern which is featured by a prominent region at the base of the cerebellum called by Evans the "central acoustic lobe." Some of the other correlations do not seem to be so well established and certainly deserve much more investigation. Unfortunately the reasoning throughout this book at times leaves the reader in a somewhat dubious and sceptical frame of mind. One is reminded of William Paley's *Natural Theology* by such statements as that on p. 70: "When herrings swim, that is, come to the surface, they discharge bubbles from their swim-bladder and these bubbles bursting must produce some sound and it is significant that herrings have an accessory organ of hearing." And the arguments in regard to the central acoustic lobe of the brain of the sole on pp. 82–83 are unconvincing because of the inconsistent use of the swim-bladder as a case in point. Evans also gives the impression on pp. 45–46 that the Weberian ossicles, since he believes them to have an auditory function, instead of being called "the tripus, scaphoid, and clastrum" (he omits the intercalarium), should be named "malleus, incus, and stapes." Surely anatomical terminology is sufficiently complex without giving structures which may be analogous, but are by no stretch of the imagination homologous, the same names.

One of the most interesting chapters in Evans' *Brain and Body of Fish* is that on the pituitary body. The author describes the results of two years' work on the pituitaries of eels taken in consecutive months through the spring, summer, and fall. He notes a great change in the size and histological appearance of the posterior lobe coincident with the pigmentary changes of the eel when about to migrate. He also presents evidence that the anterior lobe may cause exophthalmos, and that its effect on migration is indicated by its increase in size and the increase of acidophile cells immediately preceding migration, "the onset of which coincides with the appearance of both ova and sperm."

Unfortunately, Evans' *Brain and Body of Fish* is marred by such an unhappy presentation and by so many technical errors and omissions that its intrinsic value is limited. The drawings which illustrate this book are crude. There is neither an index nor a bibliography. When references are cited in the text, they are invariably incomplete, and in many instances, it is impossible to tell which statements are original, and which belong to other workers. There are annoying misspellings, misprints, and faulty punctuation marks throughout the book. It is irritating also to find generic names commonly not capitalized and specific names quite as often capitalized—*vide* p. 96, "Molva Elongata," and p. 102, "molva elongata." Finally, the style and method of expression are often needlessly involved.—DANIEL MERRIMAN, *Osborn Zoological Laboratory, Yale University, New Haven, Connecticut.*

DIE PHYSIOLOGIE DER FISCHATMUNG. By Michael Leiner. Akademische Verlagsgesellschaft, M. B. H., Leipzig. 1938: 134 pp., 117 figs., 41 tables. This volume is a revision of the work of this author (with Max Rauther) in Bronn's "Klassen und Ordnungen" together with additional treatment of more recent work. It purports to bring together the parts of the earlier work that are of special physiological interest.

The book is arranged in six sections, the first three of which deal with the effects of the outer and inner environment on fish respiration and the structure and function of the gills as organs of respiration. These chapters present a fair systematic summary of the subjects treated, with numerous tables, figures and bibliographic references. A short section considers the special problems of embryonic respiration.

More than half of the book is devoted to the two sections detailing the functions of accessory respiratory organs. The structure and respiratory function of the skin, membranes of the mouth, throat, labyrinth, intestine, swim bladder and lungs are taken up in order, followed by a chapter on the function of pseudobranchiae, acidophile cells and secretory cells of the swim bladder wall.

While the results of a large number of investigations have been condensed within the first three chapters, it seems that the author's own interest in the respiration of fish having special adaptations for living under extreme conditions has led to an over-emphasis on the study of fish types that the ordinary fisheries investigator rarely will encounter. This comment is the more pertinent when it is observed that the bibliographic citations of the first three chapters are far from complete as regards recent work. Barely a quarter of the 313 references in the book are dated 1930 or later.

By means of numerous tables and illustrations the author presents his observations on carbon dioxide elimination by specific tissues. Evidence is exhibited to indicate that the occurrence of carbonic anhydrase is concentrated in pseudobranchiae, retia mirabilia and the tissues of other organs. The pseudobranchiae of most teleosts investigated were found to contain large amounts of this enzyme, and these organs, far from being "rudimentary gills," are shown to have an important respiratory function in those fish in which they are well-developed. This subject of the control of carbon dioxide is doubtless one that is due to receive much more attention in future work than heretofore.

Although there is little in this volume that is not to be found in Bronn's "Tierreichs," the information is nevertheless so economically compiled that ecologists and physiologists should welcome it as a valuable reference.—LAWRENCE D. TOWNSEND, *State of Washington State Pollution Commission, Gig Harbor, Washington.*

MODERN SEA FISHING FROM BASS TO TUNNY. By Eric Cooper. A. & C. Black Ltd., London, 1937: ix, 1–238, several plates. $2.50.—This book treats of North Sea fishes like cod, pollack, flounders, mackerel, etc., and therefore would be of more interest to anglers along our North Atlantic coast than elsewhere in America. There is an interesting chapter devoted to tunny fishing in the British Isles, though nothing new to us is offered on technique. Mr. Cooper says that silk fishing lines will outlast linen in salt water usage, a most unorthodox statement, and certainly worth testing by American anglers.—T. DENMEAD, *U.S. Bureau of Fisheries, Washington, D.C.*

THE MAKING OF A SCIENTIST. By Raymond L. Ditmars. The Macmillan Co., New York, 1937: i–xii, 1–258, several plates. $2.75.—The average "man in the street," and the average scientist, too, for that matter, has his nose so close to the grindstone, that he sees very little around him, as he goes through this world. In *The Making of a Scientist,* Mr. Ditmars shows what a good time they are missing by maintaining such narrow interests. The book is a collection of episodes, all mildly diverting, on subjects ranging from snakes to hurricanes. A very good book to give boys aged about 12 to 15. —L. A. WALFORD, *Jordan Hall, Stanford University, California.*

EDITORIAL NOTES AND NEWS

Summary of the 1940 Meeting

THE twenty-third annual meeting of the AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS was held in Toronto, Canada, from Sunday evening, September 1 through Wednesday, September 4. The Board of Governors and the Local Committee met at 8:00 P.M. September 1, in the Royal York Hotel with VICE-PRESIDENT DYMOND presiding. Twenty-one Governors and three Local Committee members were present. Following the reading and approval of the 1939 minutes, the Chairman appointed the following committees: *Nominating*—CARL L. HUBBS, JOHN TEE VAN, and A. H. WRIGHT; *Resolutions*—H. K. GLOYD, WALTER H. CHUTE, and CHARLES M. BOGERT; *Stoye prizes*—LEONARD P. SCHULTZ, C. M. BREDER, JR., and CHARLES F. WALKER. The 52 new members secured since the 1939 meeting were formally elected to membership. The SECRETARY reported that 70 members contributed $330.05, of the total cost of $556.88, of the Cope Centenary number. He also reported that the Society has 14 fully paid Life Members, 3 partially paid Life Members, and the amount in the Endowment Fund savings account was $1600.00 on May 23, 1940. The SECRETARY represented the Society at the meeting of the Ecological Society Committee on Plant and Animal Communities at Columbus in December, 1939; he reported briefly upon the proposed Great Plains National Monument which was discussed at this meeting. The request of the Union of American Biological Societies for a donation toward running expenses was discussed, and it was decided that no contribution for this purpose should be made. The incoming president was authorized to appoint a representative to attend the Council meeting of the Union in December, 1940, and to express the views of our Society. Mr. Francis Harper's proposal regarding the placing of the children of British scientists in the homes of American colleagues of their parents was approved in principle. The SECRETARY read invitations for the 1941 meeting from the University of Cincinnati and the University of Florida. It was formally decided that the 1941 meeting would be held at Gainesville, Florida, at an April date to be chosen by the Local Committee. The necessity of assisting the Zoological Society of London to continue the publication of the *Zoological Record* during the war period was discussed. A motion that the Society should donate $50.00 in 1940 toward the publication of the *Pisces* and *Amphibia and Reptilia* sections and that members of the Society be given an opportunity to donate individually for this purpose was made by Dr. Hubbs and carried. In regard to the use of parentheses around authors' names it was decided that the Society should defer action until recommendation can be made to the International Commission; meanwhile the SECRETARY is to ascertain the views of other taxonomic societies. The herpetological index to COPEIA was discussed. It was moved that this index be published when completed; that the income from the Endowment Fund be expended for this purpose; and that a charge for the index, as determined by the Index Committee, be made to members and non-members. On motion of Dr. Schultz it was decided that one number of COPEIA in the next two years is to be dedicated to HUGH M. SMITH as an appropriate anniversary number. Mr. Chute moved that a committee of three, one of whom is to be the HISTORIAN, be appointed to consider candidates for special recognition in COPEIA and that this committee report to the Board of Governors at each meeting. Following the passage of this motion, the chairman appointed WALTER L. NECKER, CARL L. HUBBS, and A. H. WRIGHT to this committee. The meeting adjourned at 11:00 P.M.

Sessions of September 2

FOLLOWING the registration of members, DR. JOHN R. DYMOND, Director of the Royal Ontario Museum Zoology, opened the meeting with an address of welcome. Dr. Gloyd thanked Dr. Dymond on behalf of the Society.

The annual business meeting was called to order at 10:30 A.M. by VICE-PRESIDENT GLOYD. Messages from absentee members Klauber, Burton, Conant, and Howell Rivero were read by the SECRETARY.

The SECRETARY reported that 52 new members were added to the rolls in the period of 12 months since the previous meeting; 5 members died, 9 resigned, 16 were dropped, 2 were transferred, and 3 were lost because of change in address. These changes resulted in a net gain of 17 members, thereby increasing the total membership to 537. Seventeen new subscribers were obtained, and 6 were discontinued, which resulted in a net gain of 11 subscribers and increased the subscription list to 147. The total number of members and subscribers was 684 on August 31, 1940. A geographical analysis of the members and subscribers indicated that 109 copies of COPEIA go to 23 foreign countries, with Canada leading with 32 copies, followed by Great Britain with 15. The domestic copies total 575, distributed in 44 states and the District of Columbia; 99 in New York, 78 in California, and 42 in Michigan, the three leading states. The Society has neither members nor subscribers in Delaware, Idaho, and Nebraska.

The TREASURER summarized his report for the calendar-year 1939 as follows: Actual credit balance on January, 1939, $618.26; total receipts for the year 1939, including contributions toward printing, $2480.31; expenditures, including $1691.51 for the publishing of COPEIA and $328.62 for the printing of reprints, totalled — $2343.32. The actual credit balance on December 31, 1939, was $755.10.

There were no formal standing committee reports, but Mr. Necker reported on the progress of the herpetological index to COPEIA, and Mr. Bogert reported on the proposed revision of the express laws governing the shipment of reptiles. The SECRETARY gave a report on the business transacted at the Board of Governors' meeting. The Nominating Committee presented its report and the SECRETARY was instructed to cast a ballot for the following officers: JOHN T. NICHOLS and LEONARD STEJNEGER, *Honorary Presidents*; JOHN R. DYMOND, *President*; CLIFFORD POPE, W. J. K. HARKNESS, and A. F. CARR, JR., *Vice-Presidents*; M. GRAHAM NETTING, *Secretary*; ARTHUR W. HENN, *Treasurer*; HELEN T. GAIGE, *Editor-in-Chief* of COPEIA; LIONEL A. WALFORD, *Ichthyological Editor*; KARL P. SCHMIDT, *Herpetological Editor*; WALTER L. NECKER, *Historian*.

The business meeting adjourned at 11:15 A.M. and the following papers were then read:

1. **Ichthyology and Ichthyologists in Canada**—J. R. Dymond.
2. **Rana septentrionalis of New Hampshire**—Lewis H. Babbitt.
3. **Amyda spinifera of Lake Champlain, Vermont**—Lewis H. Babbitt.

During the afternoon session, which was called to order by DR. WALKER at 2:45 P.M., the following papers were presented:

4. **Snakes and snakers**—A. H. Wright.
5. **Structural Modifications in the Fangs of Spitting Cobras, with Notes on the Taxonomic Value of Dentitional Characters in Naja and Allied Genera**—C. M. Bogert.
6. **Remarks on the Smooth Green Snake, Opheodrys vernalis**—Arnold B. Grobman.
7. **Ichthyological Miscellany**—Carl L. Hubbs.

The ladies were entertained at tea in the Museum Tea Room at 4:00 P.M. The program for the evening consisted of a delightful Open House at the Department of Biology of the University of Toronto. The members viewed an exhibit of living amphibians and reptiles of Ontario assembled by Mr. LeRay and other members of the Local Committee, and enjoyed the refreshments provided by the host institution.

Sessions of September 3

THE morning session was called to order by Mr. Bogert at 10:15 A.M. for the reading of the following papers:

8. **Photography of Amphibians and Reptiles in color (Kodachrome slides)**—Robert H. McCauley, Jr.
9. **Notes on the Food of the Water Snake (Natrix s. sipedon)**—E. E. Brown.
10. **The Snakes of the Genus Stenorhina**—E. R. Dunn and Joseph R. Bailey.
11. **The Capillary Bed in the Central Nervous System of a Gymnophionan and its Possible Phylogenetic Significance**—E. Horne Craigie.

A group photograph was taken at noon. After this the ladies were entertained at luncheon in the Departmental Store of the Robert Simpson Co., Ltd.; a conducted tour of the store followed the luncheon.

The afternoon session convened at 2:30 P.M., with DR. WRIGHT presiding, for the reading of the following papers:

12. **Some Notes on the Leopard Frog Question**—E. B. S. Logier.
13. **Notes on the Salamander, Aneides aeneus**—Glenn Gentry.
14. **Further Observations on the Genus Salvadora**—Norman E. Hartweg.

15. **Life History Studies of Nocomis biguttatus in Ontario**—A. H. Carter.
16. **The Relic Fish of Death Valley**—Robert R. Miller (read by Carl L. Hubbs).
17. **Mating of the Garter Snake, Thamnophis sirtalis sirtalis (movies)**—Frieda Cobb Blanchard.
18. **Some Arizona Reptiles and Amphibians (color movies)**—Howard K. Gloyd.

The annual banquet of the Society was held in the Great Hall of Hart House at the University of Toronto at 7:00 P.M. DR. GLOYD presided and offered the toast to the King; DR. DYMOND responded with a toast to the President of the United States. Dr. Hubbs presented the newly-elected PRESIDENT, DR. DYMOND, who made a brief speech of acceptance. Dr. Wright moved that we send our greetings to two great herpetologists—MARY H. HINCKLEY and LEONHARD STEJNEGER; this motion was passed unanimously. The SECRETARY interjected a matter of business by calling for the passage of the following amendment to the By-laws which was proposed too late for action at the Governors' meeting:

Resolved, that Article IV, Sections 1 and 2 of the By-laws shall be amended to read, "The business of the Society shall be conducted by a Board of Governors. This Board shall consist of not more than 50 members, each elected for a term of 5 years. The incumbent officers of the Society shall be ex-officio members of the Board. Active Board members may be re-elected to serve any number of consecutive terms. Unless re-elected, Board members who at the time of adoption of this amendment have served 5 years or more will not be continued in office after December 31, 1940."

This amendment was carried. The second number of *Ichtherps* was distributed at the banquet and aroused great interest among those present.

Following the dinner the guests adjourned to the Music Room of Hart House to hear two delightful accounts of the experiences of J. G. OUGHTON and T. M. SHORTT of the Royal Ontario Museum of Zoology, who accompanied the Eastern Arctic Patrol in R. M. S. "Nascopie." The talks were illustrated with magnificent Kodachrome slides.

Sessions of September 4

THE morning session convened at 10 A.M. with DR. RANEY presiding. The following papers were read:

19. **New England Reptiles and Amphibians (color movies)**—Lewis H. Babbitt.
20. **Rate of Growth and Size at Maturity of Whitefish in Lake Opeongo, Algonquin Park, Ontario**—W. A. Kennedy.
21. **Body Proportions and Growth Rate in Ciscoes in Lake Nipissing, Ontario**—F. E. J. Fry and W. R. Martin.
22. **A Relationship Between Increased Turbidity and Heavier Sauger Catches in Lake Erie**—Kenneth H. Doan.
23. **The Distribution of Lampreys in Ohio**—Milton B. Trautman.
24. **A Method of Comparing the Head Lengths of Trout from Different Environments**—C. McC. Mottley.
25. **A Peculiar Structure of the Anal Fin of Capelin**—V. D. Vladykov.
26. **Remarks on the Salvelinus marstoni in the Laurentides Park**—V. D. Vladykov.

During the morning a number of members enjoyed a conducted tour of the Royal Ontario Museum. The afternoon meeting was called to order at 2:30 P.M. by Professor Harkness for the reading of the following papers:

27. **A Comparison of Stomach Contents and Feeding Habits of Three Minnows from Florida**—Nelson Marshall.
28. **Field Work of the New York Aquarium in Mexico (movies)**—Charles M. Breder, Jr.
29. **The Present Status of South American Freshwater Ichthyology**—William A. Gosline.
30. **Collecting Fishes and Other Specimens in the Phoenix and Samoan Islands in 1939**—Leonard P. Schultz.
31. **On the Trail of the Tarpon (movies)**—Charles M. Breder, Jr.

MR. CHUTE, representing the Resolutions Committee, submitted the following resolution which was accepted unanimously:

Whereas, we, the members of the American Society of Ichthyologists and Herpetologists, convened in our annual meeting at Toronto, Ontario, September 4, 1940, appreciate the excellent work of the Local Committee on Arrangements in planning and conducting this very successful meeting,

Therefore, we wish to extend our sincere thanks to the members of this Committee,

Further, we wish to express our appreciation of the cordial hospitality extended to this Society by the Royal Ontario Museum of Zoology and the Department of Biology of the University of Toronto.

The Stoye Prizes of $10.00 each for the best student papers in ichthyology and herpetology were awarded to MR. KENNETH H. DOAN for paper no. 22 and to MR. ARNOLD B. GROBMAN for paper no. 6.

An interesting feature of the meeting was a specially prepared exhibition, in the galleries of the Royal Ontario Museum of Zoology, of the works of Canadian ichthy-

ologists and publications upon Canadian zoology. Drawings by E. B. S. LOGIER, paintings by MICHAEL BEVAN, and snake photographs by A. H. WRIGHT added to the attractiveness of the exhibit.

The attendance at Toronto was larger than at any previous meeting; the register was signed by 60 members, 23 wives and children of members, and 66 guests, making a total of 149, of whom 87 were from the United States.—M. GRAHAM NETTING, *Secretary*.

Meeting of the Western Division

THE twelfth annual meeting of the AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS was held at the University of Washington, Seattle, June 19–21, 1940. On Wednesday, June 19, a Symposium on Salmon Problems on the Pacific Coast of North America, with PRESIDENT W. M. CHAPMAN presiding, was held, during which the following papers were read and discussed:

1. **Bristol Bay Salmon Investigations**—F. A. Davidson.
2. **The Fresh Water Existence of the Genus Oncorhynchus and Its Relation to the Economic Importance of the Fishery**—L. A. Royal.
3. **The Effects of Civilization on the Salmon Population in the Columbia River Basin**—J. A. Craig.
4. **The Future of the Columbia River Salmon Fishery**—Willis H. Rich.
5. **Salmon Problems in California**—G. H. Clark.
6. **The Shasta Dam Salmon Salvage Problem**—P. R. Needham.
7. **Salmon Problems on the Coast of British Columbia**—A. L. Pritchard.
8. **Fraser River Salmon Problems**—W. F. Thompson.

On Tuesday, June 20, the following papers were presented:

9. **Marginal Climates for the Amphibia and Reptilia of British Columbia**—Ian McTaggert Cowan.
10. **Miocene Fish Faunas of Southern California**—Lore R. David.
11. **Development of the Scales of the Chinook Salmon, Oncorhynchus tschawytscha**—Arthur Welander.
12. **The Fecundity of Certain Puget Sound Flatfishes**—R. T. Smith.
13. **The Reptiles of Washington**—James R. Slater and Murray L. Johnson.
14. **An Ecological Study of the Cunner, Tautoglabrus adspersus, at the Isles of Shoals**—Floyd G. Bryant.
15. **Herpetology in Idaho**—James R. Slater and John W. Slipp.
16. **Collecting from Rattlesnake Dens**—Robert Owen.

At 11:55 A.M. the members convened for the annual business meeting, at which the following officers were elected for the ensuing year: *President*, TRACY I. STORER; *Vice-President*, R. S. CROKER; *Secretary-Treasurer*, MARGARET STOREY. In the afternoon a tea was held for the members in the Fisheries Halls. At the Thursday evening session, held in cooperation with the Northwest Bird and Mammal Society, were shown colored movies of birds and fur seals on the Pribilof Islands, of sea otters off the California coast below Monterey, and of the Alaska coast and the Alaska salmon, taken from boat, plane, and shore by F. A. DAVIDSON, and slides of the charming drawings of sea otters in action, by EDNA FISHER.

On Friday morning a field trip, under the leadership of MR. SEYMOUR, was made to the frozen fish exhibit and various commercial fish establishments in the Seattle water front.—MARGARET STOREY, *Secretary*.

News Notes

DR. L. C. STUART, of the Museum of Zoology, University of Michigan, has returned from an eight months trip in Guatemala, the major objective of which was to complete his studies on the herpetofauna of the Alta Verapaz, begun in 1938. Dr. Stuart was able also to visit briefly the biologically unknown Cuchumatanes Mountains in northern El Quiché.

DR. E. W. GUDGER, Associate Ichthyologist and Bibliographer of the American Museum of Natural History, and DR. R. M. ANDERSON, of the National Museum of Canada, have been elected Corresponding Members of the Zoological Society of London.

G. C. CARL has resigned from the Fisheries Research Board of Canada to accept a position with the Provincial Museum, Victoria, British Columbia.

FLETCHER A. REYNOLDS has been appointed Curator of Reptiles in the Toledo Zoo.

THE AMERICAN WILDLIFE INSTITUTE is cooperating with individuals in supporting a research project on salmon restoration. The work will be done at the University of Maine under one or two fellowships to be known as the William Converse Kendall Memorial Fellowships in honor of the fine contributions by Dr. Kendall to fisheries science and in particular to the study of salmon in New England; also in recognition of the generous gift by his daughter, Mrs. Harrison Warner, of Dr. Kendall's notes and library to the University of Maine. It is hoped that the Fish and Wildlife Service will, in cooperation with the states, conduct a survey of the possibilities of salmon restoration in New England. The funds from the Institute and individuals have already assured the support of a fellowship for work on the Dennys River for this year but some additional funds are needed for expenses in connection with the investigation, and for this purpose additional contributions (payable to the University of Maine, Orono, Maine) are being invited.

Ground was broken on August 8 for the new laboratory building of the FISH AND WILDLIFE SERVICE at the University of Maryland, College Park, Md. This will be a unit in the group of laboratory buildings of the Department of the Interior, which are situated on land donated by the state of Maryland.

THE ASSOCIATED FISHING TACKLE MANUFACTURERS during the summer made a grant of $1,000 to the University of Michigan, for the support of investigations which bear on fish management and the increase in the supply of game fish. Under this grant Mr. Raymond E. Johnson is conducting a fish and fisheries survey of Nebraska under a part-time fellowship at the University. Support will be given to hatchery experiments on the effects of rearing trout under different temperatures on which project Mr. W. Robert Martin will conduct experiments. Other fish-management projects will also be given some support.

THE UNIVERSITY OF TEXAS has received gifts of several acres of land and a group of buildings, to be used for a marine biological station.

Announcements

SINCE the ZOOLOGICAL RECORD is a tool of major importance to zoologists throughout the world the Society will donate $50.00 in 1940 toward the cost of publishing the *Pisces* and *Amphibia* and *Reptilia* sections. Since this sum is all too small the Governors suggest that individual members may wish to assist in this good work by sending personal contributions to the TREASURER to increase the amount to be sent to the Zoological Society of London. Members who do not feel able to make outright donations are earnestly requested to aid the Record by ordering current (1939) sectional reprints and by purchasing back numbers of these sections to complete their sets.

Volume 1, part 10, of the Journal of the Society for the Bibliography of Natural History is devoted to a facsimile of R. H. Beddome's articles on Indian reptiles 1862-1870, with an introduction by Malcolm Smith. Seven extremely rare reprints, comprising 62 pages of text and 10 plates, some with figures in color, are reproduced. The income of the issuing organization is derived from the sale of its publications and it is hoped that American herpetologists will assist in the valuable work of reproducing out-of-print items by purchasing copies of the Beddome facsimile. The price is 15s.

A member who wishes to remain anonymous has offered to contribute the sum of $100.00 annually to augment the growth and importance of annual meetings. The sum may be spent for traveling expenses, prizes, or other purposes as determined by the officers of the Society. The SECRETARY will welcome suggestions for the most effective use of this fund.

The name of JOHN W. BAILEY was inadvertently omitted from the printed list of contributors to the Cope number.

Financial aid in publishing this issue of COPEIA has been received from the GEOLOGICAL AND NATURAL HISTORY SURVEY OF WISCONSIN, and from SIDNEY C. T. HSIAO.

COPEIA IS THE JOURNAL OF THE AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS

Officers

Honorary Presidents—LEONHARD STEJNEGER (Herpetology), U.S. National Museum, Washington, D.C., and JOHN TREADWELL NICHOLS (Ichthyology), American Museum, New York City.

President—JOHN R. DYMOND, Royal Ontario Museum of Zoology, Toronto, Ontario.

Vice-Presidents—CLIFFORD POPE, Field Museum, Chicago, Illinois: W. J. K. HARKNESS, University of Florida, Gainesville, Florida: A. F. CARR, JR., University of Florida, Gainesville, Florida.

Treasurer—ARTHUR W. HENN, Carnegie Museum, Pittsburgh, Pennsylvania.

Secretary—M. GRAHAM NETTING, Carnegie Museum, Pittsburgh, Pennsylvania.

Editors—Editor-in-Chief, HELEN T. GAIGE, Museum of Zoology, University of Michigan, Ann Arbor, Michigan: *Ichthyological Editor,* LIONEL A. WALFORD, Jordan Hall, Stanford University, California: *Herpetological Editor,* KARL P. SCHMIDT, Field Museum, Chicago, Illinois.

Historian—WALTER NECKER, Chicago Academy of Science, Chicago, Illinois.

Officers of Western Division

President—TRACY I. STORER, University of California, Davis, California.

Vice-President—R. S. CROKER, California State Fisheries Laboratory, Terminal Island, California.

Secretary-Treasurer—MARGARET STOREY, Stanford University, California.

Honorary Foreign Members

DAVID M. S. WATSON; LEO S. BERG; W. WOLTERSTORFF; SIR ARTHUR SMITH WOODWARD; MAJOR STANLEY S. FLOWER; C. TATE REGAN; COLONEL F. WALL; L. D. BRONGERSMA; GEORG DUNCKER; ADOLPHO LUTZ; ROBERT MERTENS; J. R. NORMAN; H. W. PARKER; JACQUES PELLEGRIN; P. J. SCHMIDT.

Back numbers of COPEIA, all yet available, may be procured through the Secretary. Prices will be furnished on application.

Subscription, $3.00 per annum, 75c a copy.

Dues to Society, $3.00 per annum, including subscription to COPEIA.

Life Membership, $75.00, payable in one sum or three annual payments.

Dues and subscriptions are payable to the Society, through the Secretary.

Members should notify the Secretary immediately of any change in address.

Manuscripts, news items, and all correspondence regarding the Journal, should be addressed to one of the Editors.

Manuscripts should be submitted on good paper, as original typewritten copy, double-spaced, carefully corrected. Galley proof will be furnished authors.

Original contributions, not to be published elsewhere, are alone acceptable.

Reprints are furnished at approximate cost.

Figures, author's corrections, expensive tabular matter and unusually long articles may be charged in whole or in part to the author, at the discretion of the Editors.


ΙΧΘΤΣ
ΒΑΤΡΑΧΟΣ
ΕΡΠΕΤΟΝ